THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 109.)

DVII.—ROCK ISLAND, ILL.

Rock Island, Illinois, in lat. 41° 30′ N., long. 90° 25′ W., is on the Mississippi River. Settled in 1830, it was incorporated a city in 1849. Water-works were built for the city in 1871 by the Holly Manufacturing Co., taking the supply from the Mississippi River. A 24-in. cast-iron pipe conveys the water 2,100 ft. from the main channel of the river to a basin of stone masonry 80 ft. in diameter and 28 ft. deep, having a cross wall with screens. The first steam engines had 2 cylinders of 14 in. diameter and 24 in. stroke, driving a shaft to which were geared 6 single-acting pumps of 14 in. bore and 12 in. stroke. In 1882, a compound engine was erected with 4 steam cylinders of 19 in. diameter, and 4 double-acting pumps of 10¼ in. bore, all of 27 in. stroke. Water is pumped directly into the mains with an ordinary pressure of 60 lbs., and fire pressure of 140 lbs.

Distribution is by 15⅔ miles of cast-iron pipe of from 20 to 4 in. diameter, with 106 fire hydrants, 88 gates and 926 taps. The city contributes $5,250 per year for fire protection. Service pipes of lead and of wrought iron are used. The population in 1880 was 11,659. The daily consumption in 1882 was 1,800,000 gallons.

The works cost $220,000. The bonded debt is $113,000, at 8 per cent. interest. The expenses in 1882 were $6,350, and the receipts $20,250.

The works are managed by a committee consisting of the Mayor and two of the City Council. Fred. A. Cramer is the Superintendent.

DVIII.—MADISON, WIS.

Madison, Wisconsin, in lat. 43° 4′ N., long. 89° 23′ W., is on undulating ground, on a peninsula between Lakes Mendota and Monona.

Settled in 1835, it was incorporated a city in 1856.

Water-works were built by the city in 1882, after the plans and under the superintendence of Chester B. Davis, C. E., taking the supply from artesian wells. The first well is of 5-in. bore and 750 ft. deep, passing through 215 ft. of drift and 535 ft. of Potsdam sandstone to granite. The water rises in it to 4½ ft. above the surface of Lake Mendota. Three other wells of 8-in. bore are in progress of boring. The water is much softer than that of the lake.

At present the water is pumped directly into the mains by two sets of Knowles pumps geared to two Reynolds Corliss engines. One engine 14 by 36 in., drives two 12 by 16 in. pumps, and one engine 18 by 42 in. drives two 16 by 24 in. pumps. The engine speed is 4½ times that of the pumps. The ordinary pressure at the pumps is 60 lbs., and the fire pressure 110 lbs. A plate-iron stand-pipe 4 ft. in diameter and 150 ft. high is to be erected.

Distribution is by 12 miles of cast-iron pipe of from 16 to 4 in. diameter, with 86 fire hydrants, 70 gates and 60 taps. Service pipes are of lead. The works went into operation in November, 1882.

The population in 1880 was 10,325.

The works now completed and in progress are to cost $100,000. The bonded debt is $76,000 at 5 per cent. The works are managed by a superintendent, who reports directly to the City Council.

John B. Heim is the Superintendent.

DIX.—HILLBURN, NEW YORK.

Hillburn, New York, in Rockland County, was formerly called Woodburn. It is in lat. 41° 10′ N., long. 74° 20′ W., on the Ramapo River, in a hilly region. It was founded in 1872 by the Ramapo Wheel & Foundry Company, for homes for their operatives. Water-works were built by the company after plans of W. W. Snow, their Superintendent. The supply is taken from a small stream fed mainly by springs. A dam across the stream forms a small reservoir about 60 feet above the village.

Distribution is by one mile of Wyckoff wood pipe of 6, 4 and 2 in. diameter, with 4 gates and 37 taps. In the centre of the village is a stand pipe of 3 in. diameter and 45 feet high. The water is allowed to flow continuously, and the waste from the stand-pipe forms a rose jet fountain in an ornamental lake in the public grounds.

The works cost $3,500. The present population is about 350.

DX.—SAN ANTONIO, TEX.

San Antonio, Texas, in lat. 29° 30′ N., long. 98° 25′ W., is on the San Antonio and San Pedro Rivers. The business portion is nearly level, and on each side the ground rises gradually to an elevation of about 100 ft.

It was settled by the Spaniards in 1714, and received a charter from the King of Spain in 1733. It was incorporated a city in 1873. Water-works were built in 1878 by a private company, after plans of W. R. Freeman, taking the supply from springs at the head-waters of the San Antonio River, 4 miles from the city. A riprap damf built by the Spaniards, creates a head and fall o-9 ft., which furnishes power for two eclipse tur, bines, which drive two Worthington pumps of 14-in. bore and 10½-in. stroke, which lift the water to a reservoir in excavation and embankment, 18 ft. deep, with slopes paved with limestone, and holding 5,000,000 gallons, at 150 ft. above the city.

Distribution is by 15 miles of cast-iron pipe of from 16 to 4 in. diameter, with 139 fire hydrants, 100 gates and 1,020 taps. The city pays $10,000 per year for fire protection and exempts the company from taxation. Service pipes are of galvanized iron.

The population in 1880 was 20,550. The consumption is not known.

The capital stock of the company is $150,000. The works have cost $165,000. The bonded debt is $160,000. No further financial statistics are given.

George W. Brackenridge is President, and John Frazier Secretary of the company.

The United States Army Depot at this port, has independent water-works, pumping the water by steam to a stand-pipe inclosed in a stone tower.

DXI.—ADAMS, MASS.

Adams, Massachusetts, in lat. 42° 38′ N., long. 73° 8′ W., lies along the valley of the south branch of the Hoosac River. It was settled about 1740.

Water-works were built by the town in 1873, chiefly for fire protection, taking the supply from impounding resevoirs on small brooks. The first dam built in 1873 at Cheshire Harbor impounds 5,000,000 gallons, and another built in 1882, about the same amount.

The pipes supply water to South Adams under 140 ft. head, the village of Maple Grove under 200 ft. head and the village of Renfew under 75 ft. head, and also a small manufacturing village of 500 inhabitants at the American Zylonite Works, a mile from Renfrew.

There are 8 miles of cast-iron pipe of from 12 to 4 in., diameter with 156 five hydrants, 25 gates and 800 taps and 11 meters. Service pipes are of wrought iron. The population supplied is 6,000. The consumption is not known.

The works cost $140,000. The bonded debt is $127,000 at 5 and 6 per cent. The receipts are $7,000 per year and the expenses nominal. C. A. Waters is the Superintendent.

The receipt of statistics as follows is acknowledged with thanks.

From W. E. Pettee, C. E., statistics of water-works of Adams, Mass., Amesville, Conn., and Phoenix Furnace, N. Y.

(*To be Continued.*)

CORRESPONDENCE.

REVERSED BLUE PROCESS.

CHICAGO, March 9, 1883.

EDITOR ENGINEERING NEWS:

Could any of the readers of your practical journal throw light on the subject of Reversed Blue Process printing.

For the potash bath we dissolve as much of the yellow prussiate as hot water will take up; acid bath 4 ozs. sulphuric acid to the gallon of water, and expose from four to six minutes, and after many trials we can't get a map with clear white background. It always looks blue.

As the apparatus and outfit have cost well on to $200 we want to get some return for our outlay, and will be much obliged for information.

Yours, X. Y.

[Since the receipt of the above we were informed by a large manufacturer of this city that the reversed blue process (blue lines on a white ground) was so expensive as to prohibit its general use. Gray or brown lines on a white ground are cheaper. The exact method they are not willing to make public. We shall be pleased to publish any information which our readers may send us on this subject.]

"TRACKLAYING IN 1882 ON THE MAIN LINE OF THE CANADIAN PACIFIC RAILWAY."*

BY HENRY PURDON BELL, M. INST. C. E.

The contract upon which the operations to be described were conducted extended from a point about 170 miles west of Winnipeg to a point 500 miles still further west, and was that class of work known as "prairie-grading." It must not, however, be supposed that the country through which the line passes is a uniform level. It became necessary in many places to use a large proportion of curvature and occasional gradients of 53 ft. per mile, with quantities as high as 30,000 cubic yards of excavation to the mile. The embankments were 14 ft. wide on the top.

The contract for these 500 miles was given by the Canadian Pacific Railway Company to Messrs. Langdon and Shephard, an American firm, and the organization employed by them was the result of years of experience on similar works in the United States. The Railway Company bound themselves to forward all material and supplies to the contractors. This portion of the work was conducted by the General Manager of the company, Mr. Van Horne. Taking into consideration the distance that the contractors were working from their base of supplies and material, the detention caused by excessive floods in the spring of 1882, the rapidity with which the distance from the base of supplies was extended, and many other disadvantages, great in the aggregate, it is but fair to say that the forwarding of material and supplies was half of the season's work, and that the season's work, taken as a whole, has been considered by good judges the most successful of its kind yet executed on the American continent.

TRACKLAYING.

When a train-load of sleepers was forwarded, it was unloaded by 30 men, who reloaded the same on 35 two-horse wagons, which were sent to the front as soon as loaded.

At the end of the track 6 men unloaded these sleepers, and 20 more put them in place ready to receive the rails as they were removed from the iron car.

The rails were unloaded from the trains in quantity equal to half-mile of track at a time, and sleepers for the same distance. Twelve men unloaded the rails, and when the train moved back these same men reloaded these rails upon the iron cars, which were sent forward, with two horses to each car. These horses traveled as fast as possible to the end of the track.

The iron car resembled in its proportions an ordinary low four-wheeled truck, and was furnished with four rollers to neutralize the friction encountered in pulling the rails from the iron car and dropping each length in place upon the sleepers. Four of these cars were used in getting the rails to the end of the track, and the method of operating them was as follows: At the beginning of a day's work the four iron cars stand upon the track in front of the boarding-car, the track being clear to the end. The foremost car is taken to the pile of rails, there loaded, and sent to the front at once. Another iron car is then pulled forward to take its place. By the time that the car first forwarded has been unloaded, the second car loaded is upon the track immediately behind it. The first car is then lifted up, with its side resting on the ends of the sleepers clear of the rails, and the loaded car is passed by it to be handled by the tracklayers. The first car, on its return to the rail-pile, meets there a third car loaded, and is again lifted as before described, and the loaded car drawn forward, leaving the third car ready to start for the end of the track. Briefly described, the operations of these cars consist of passing and re-passing each other, in the mode described, between the pile of rails and the end of the track. Immediately behind the forward iron car at the end of the track are twelve men putting on fish-plates and full-bolting them; these men do nothing else, but they are obliged to keep pace with the laying of the rails, in order to leave the track-joints in the position for the car coming behind.

Behind the bolters are six men distributing track-spikes, commonly called "spike-peddlers."

The mode of distributing sleepers in America originated the use of the term "line-side of the track;" that is to say, that side of the track upon which the line is stretched with which the sleeper-ends are made to coincide, and is generally the right-hand side facing the track-end, but which side is immaterial. The side opposite the line-side is called the "gauge-side." Track-spiking is divided into joint, quarter and center-spiking.

After the six men described as spike-peddlers come two men called line-spikers, accompanied by a nipper, who holds up the end of the sleeper with a bar while the spikes are being driven. These two men spike the sleeper upon either side of the rail-joint, but only upon the line-side of the track. Opposite these two spikers and the nipper is a similar gang to spike the joints upon the gauge-side of the track, first using the gauge to place the rail-ends the proper distance apart. Immediately behind the two line-spikers come the two quarter-spikers and a nipper, and opposite to these another set of gauge-spikers. Behind these again are the center-spikers and nipper, with their gauge-spikers opposite, the duty of each gang being exactly the same.

It will therefore be seen that the gauge of the track has been tested at five different points within the length of each pair of 30-ft. rails, and is practically perfect.

To each 30-ft. rail are fifteen sleepers 2 feet

* Paper No. 1,006, from the Institution of Civil Engineers.

apart from center to center, and upon each side of the track are sixteen spikers and eight nippers, forty-eight men in all, including all the line and gauge spikers before mentioned. The spiking is, therefore, done in exact rotation by one gang following the next ahead to a sleeper in similar position each successive length of rails. Behind the gangs just described are six men and a foreman, throwing the track into exact line, which completes the operation of tracklaying. To give an idea of the speed and precision attained by this method of tracklaying, it may be stated that during the month of August, 1882, 92⅝ miles were completed, the maximum distance in any one day being 4½ miles. Mr. Donald Grant, who was in charge of operations at the end of the track, offered to lay, for the members of the Dominion Press Association, who visited the work in August, 1882, one mile of track in one hour. The Association remained upon the ground for half an hour, and saw the completion of half a mile. After the track has been properly lined, the work next in order is called surfacing, which consists of leveling lumps, filling holes and bringing the rails parallel to grade, or as near as possible thereto. This is effected by raising any low portions of track and re-bedding the ties with material taken from the slope shoulders on each side. The form of embankment thus made is called a rain-section, and this last operation leaves the track in order for the running of trains.

Briefly summarizing, the tracklaying gang consisted of :

30	men	unloading and reloading sleepers.
6	"	" sleepers from teams.
20	"	placing sleepers to receive rails.
12	"	pulling rails from iron cars to sleepers.
6	"	spike-peddlers.
12	"	bolters.
6	"	runners with iron cars.
12	"	unloading and reloading rails.
32	"	spikers.
16	"	nippers.
7	"	liners.
159	in all.	

Besides these, there are thirty-five teams and thirty-five teamsters distributing sleepers under the direction of two foremen; making a grand total of one hundred and ninety-six men and seventy horses in and connected with the business of tracklaying.

ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS NO. 1,528 CHESTNUT STREET, PHILADELPHIA, PA.

Record of Regular Meeting, March 3, 1883.

President Henry G. Morris in the chair; 27 members and one visitor present.

Mr. Horace See described the S. S. Mariposa, built for the Oceanic S. S. Co., of San Francisco, Cal., by Wm. Cramp & Sons S. and E. B. Co., of Philadelphia.

The Mariposa is of the following dimensions: Length, 330 ft.; breadth, 41 ft.; depth of hold, 26 ft.; gross tonnage, about 3,000 tons.

The vessel is of the three-deck type, with the addition of a flush hurricane deck, extending fore and aft and from side to side, the hull being carried up to meet it. On the hurricane deck forward are located the social hall, pilot-house and state-rooms for captain, 1st and 2d officers, and aft, a small house for smoking room.

The vessel will have two masts and one oval smoke-stack.

The grand saloon is located on the upper deck, forward of the machinery space, extending from side to side, with state-rooms for 100 first-class passengers arranged forward of it and amidships on both sides of the machinery. The principal wood used in the finish of the saloon will be oak, relieved with maple and mahogany, In place of the old-fashioned dead-eye side-light, square openings of liberal size are cut in the sides, provided with iron shutters on the outside and glazed sash on the inside. This arrangement will add vastly to the comfort of the passengers. The incandescent electric light will be fitted all over the ship.

The accommodations for officers and crew are to be on the upper deck aft of the machinery space.

Steam steering gear of approved make will be located in pilot-house, with hand-power attachment in reserve. Screw gear will be placed aft for additional security. A steam windlass, with capstan, will be arranged forward and two steam capstans aft. A steam deck pump will be provided both forward and aft. There will be steam elevators in each of the main hatches for loading and unloading cargo.

The propelling machinery will be of the independent, compound, inverted, direct-acting, three-cylinder type, of about 3,000 horse-power, with the high pressure cylinder 43 inch diameter, the two low pressure 61 inch diameter, and all 51 inch stroke of piston. An independent centrifugal pump will be used for circulating water through the condenser, and for freeing the ship in case of a large leak. The engines will be reversed by the steam gear made by this firm. The propeller will be built up and made of charcoal iron. Steam of 90 pounds pressure will be supplied by two single-ended and two double-ended boilers. For port use and emergencies at sea a large donkey boiler will be placed on upper deck. For hoisting ashes, an arrangement of steam gear, dispensing with any attendance above, designed by one of the owners, will be used. Steam pumps for feeding main boilers, for extinguishing fires, etc., will be located in machinery space.

The Secretary presented, for Prof. Mansfield Merriman, a description of a "Graphic Solution of Cubic Equations."

Mr. Wm. P. Osler presented a table for bolts, nuts and threads, prepared by Mr. H. C. Slaney, gas engineer, and himself.

The Secretary presented tracings of device for holding transit pole vertically, and shelf for holding field instruments in vertical position while temporarily out of use in office, contributed to the Club by Mr. Chas. E. Chandler, Civil Engineer, Norwich, Conn. The former consist of a bubble tube framed at right angles to the rod, and the latter of a shelf notched out to admit the legs under the tripod head, and provided with a slide in front to retain the instrument in place.

The Secretary read a communication from Mr. C. René, of Stettin, describing a process for the drying of wood, intended especially for the preparation of wood for musical instruments, but, perhaps, otherwise useful. It is described as follows:

The wooden boards are so arranged in a large iron kettle that gases may freely circulate over their entire surface, and exposed, in the first place, for twelve hours to the drying effects of hot air; after this the kettle is closed, reheated by the apparatus below and the air exhausted, when the kettle is filled with the oxygen ozonized by electrical sparks passing continually between two points of platina, forming the end poles of two wires conducted through tubes of glass into the kettle. The ozone is said to act so energetically upon the heated wood that it consumes the destroying resinous, oily or other parts in from 12 to 24 hours.

HOWARD MURPHY, Secretary and Treasurer.

WATER-WORKS REPORT, BROCKTON, MASS.—The annual report has been presented to the Board of Aldermen. The report states that there are now 695 water takers in the city, 385 of whom have been connected during the past year. The entire amount thus far expended in the construction of the water-works is $235,363.91. There are now about 15 miles of main pipes in service, and the supply of water, as proven by the severe test of last summer, is ample to meet the growing necessities of the city. The quality of the water is also noticeably good, being far superior to that of many other cities. The Commissioners urge the laying of another 10-inch main from Belmont street through Pond street to Clifton avenue, in Campello, in order to gain a complete circulation, which will greatly improve the water in the cross lines. The cost of this main would be in the vicinity of $11,000, and it is recommended that work be begun as soon as the season will admit. The Commissioner further recommend that the City Treasurer be authorized to issue bonds to the amount of $25,000, the proceeds to be placed to the credit of the Water Department, to be expended in such extensions and connections as may be deemed for the best interests of the city.

DAM ACROSS THE OTTAWA RIVER, AND NEW CANAL AT CARILLON, QUE.

[Written for Engineering News.]

BY ANDREW BELL, RESIDENT ENGINEER.

The natural navigation of the Ottawa River from the head of the Island of Montreal to Ottawa City—a distance of nearly 100 miles—is interrupted between the villages of Carillon and Grenville, which are thirteen miles apart, by three rapids, known as the Carillon, Chûte à Blondeau and Longue Sault rapids, which are in that order from east to west. The Carillon Rapid is two miles long, and has, or had, a fall of 10 ft.; the Chûte à Blondeau, a quarter of a mile, with a fall of 4 ft., and the Longue Sault six miles, and a fall of 46 ft. Between the Carillon and Chûte à Blondeau there is or was a slack water reach of three and a half miles, and between the latter and the foot of the Longue Sault a similar reach of one and a quarter miles.

Small canals, limited in capacity to the smaller locks on them, which were only 109 ft. long, 19 ft. wide, and 5 to 6 ft. of water on the sills, were built by the Imperial Government as a military work around each of the rapids. They were begun in 1819 and completed about 1832. They were transferred to the Canadian Government in 1856. They are built on the north shore of the river, and each canal is about the length of the rapid it surmounts.

The Grenville Canal (around the Longue Sault) with seven locks, and the Chûte à Blondeau with one lock, are fed directly from the Ottawa. But with the Carillon that method was not followed, as the nature of the banks there would have, in doing so, entailed an immense amount of rock excavation—a serious matter in those days. The difficulty was overcome by locking up at the upper or western end 13 feet and down 23 at lower end, supplying the summit by a "feeder" from a small stream, called the North River, which empties into the Ottawa three or four miles below Carillon, but is close to the main river, opposite the canal.

In 1870-71 the Government of Canada determined to enlarge these canals to admit of the passage of boats requiring locks 200 ft. long, 45 ft. wide, and not less than 9 ft. of water on the sills at the lowest water. In the case of the Grenville Canal this was, and is being, done by widening and deepening the old channel and building new locks along side of the old ones. But to do that with the Carillon was found to be inexpedient. The rapidly increasing traffic required more water than the North River could supply in any case, and the clearing up of the country to the north had materially reduced its waters in summer and fall when most needed. To deepen the old canal so as to enable it to take its supply from the Ottawa would have caused the excavation of at least 1,250,000 cubic yards of rock, besides necessitating the enlargement of the Chûte à Blondeau also.

It was therefore decided to adopt a modification of the plan proposed by Mr. T. C. Clarke, of the present firm of Clarke, Reeves & Co., several years before when he made the preliminary surveys for the then proposed "Ottawa Ship Canal," namely to build a dam across the river in the Carillon Rapid, but of sufficient height to drown out the Chûte à Blondeau, and also to give the required depth of water there.

During the summer and fall of 1872 the writer made the necessary surveys of the river with that end in view. By gauging the river carefully in high and low water, and making use of the records which had been kept by the lock-masters for twenty years back, it was found that the flow of the river was, in extreme low water, 26,000 cubic feet per second, and in highest water 190,000 cubic feet per second; in average years about 30,000 and 150,000 cubic feet respectively. The average flow in each year would be nearly a mean between those quantities, namely about 90,000 c. ft. per second. It was decided to locate the dam where it is now built, namely, about the center of the Carillon Rapid, and a mile above the village of that name, and to make it of a height sufficient to raise the reach between the head of Carillon and Chûte à Blondeau about six feet, and that above the latter two feet in ordinary water. At the site chosen the river is 1,800 feet wide; the bed is solid limestone, and more level or flat than is generally found in such places—the banks high enough and also composed of limestone. It was also determined to build a slide for the passage of timber near the south shore (see map) and to locate the new canal on the north side.

Contracts for the whole works were given out in the spring of 1873, but as the water remained high all the summer of that year very little could be done in it at the dam. In 1874 a large portion of the foundation, especially in the shallow water, was put in. 1875 and 1876 proved unfavorable and not much could be done, when the works were stopped. They were resumed in 1879, and the dam, as also the slide, successfully completed, with the exception of gravelling of the dam, in the fall of 1881. The water was lower that summer than it had been for thirty-five years before. The canal was completed and opened for navigation the following spring.

THE DAM.

In building such a dam as this the difficulties to

be contended against were unusually great. It was required to make it as near perfectly tight as possible, and be, of course, always submerged. Allowing for water used by canal and slide and the leakage, there should be a depth on the crest of the dam in low water of 2.50 ft., and in high of about 10 ft. These depths turned out ultimately to be correct. The river reaches its highest about the middle of May, and its lowest in September. It generally begins to rise again in November. Nothing could be done except during the short low-water season, and some years nothing at all. Even at the most favorable time the amount of water to be controlled was large. Then, the depth at the site varied in depth from 2 to 14 ft., and at one place was as much as 23 ft. The current was at the rate of from 10 to 12 miles an hour. Therefore, failures, losses, etc., could not be avoided, and a great deal had to be learned as the work progressed. I am not aware that a dam of the kind was ever built, or attempted to be built, across a river having such a large flow as the Ottawa.

The method of construction was as follows: Temporary structures of various kinds, suited to position, time, etc., were first placed immediately above the site of the dam to break the current. This was done in sections, and the permanent dam proceeded with under that protection.

In shallow water, timber sills, 36 ft. long and 12 in. × 12 in., were bolted to the rock up and down stream, having their tops a uniform height, namely, 9.30 feet below the top of dam when finished. These sills were, where the rock was high enough, scribed immediately to it, but if not, they were "made up" by other timbers scribed to the rock, as shown by Figs. 4 and 5. They were generally placed in pairs, about six feet apart, and each alternate space left open for the passage of water, to be closed by gates as hereafter described. Each sill was fastened by five 1½-in. bolts driven into pine plugs forced into holes drilled from 18 in. to 24 in. into the rock. The temporary rock was then removed as far as possible to allow a free flow of the water.

In the channels, of which there are three, having an aggregate width of about 650 feet, cribs 46 feet wide up and down stream were sunk. In the deepest water, where the rock was uneven, they covered the whole bottom up to about five feet of the level of the sills, and on top of that, isolated cribs 46 in. ×6 in. and of the necessary height were placed seven feet apart, as shown at *C*, figs. 2 and 3. At other places similar narrow cribs were placed on the rock, as shown at *D*, Figs. 2 and 3. The tops of all were brought to about the same level as the before mentioned sills. The rock bottom was cleaned by divers, of all boulders, gravel, etc. The cribs were built in the usual manner, of 12 in. × 12 in. timber, generally hemlock, and carefully fitted to the rock on which they stand. They were fastened to the rock by 1½-in. bolts, five on each side of a crib, driven into pine plugs as mentioned for the sills. The drilling was done by long runners from their tops. The up-stream side of the cribs were sheeted with 4 in. tamarac plank.

On top of these sills and cribs there was then placed all across river a platform from 36 to 46 feet wide, made up of sawn pine timber 12 in. × 12 in., each piece being securely bolted to its neighbor and to the sills and cribs below. It was also at intervals bolted through to the rock.

On top of the "platform" there was next built a "flat dam of the sectional form shown by Fig. 1. It was built of 12 in. × 12 in. sawn pine timbers, securely bolted at the crossings and to the platform and sheeted all over with tamarac 10 in. thick and the crest covered with ½-in. boiler plate 3 ft. wide. The whole structure was carefully filled with stone —field stone, or "hard head" generally being used for the purpose.

At this stage of the works, namely, in the fall of 1881, the structure presented somewhat the appearance of a bridge with short spans. The whole river—fortunately low—flowed through the sluices, of which there were 113, and also through a bulkhead which had been left alongside of the slide with a water width of 60 ft. These openings had a total sectional area of 4,400 sq. ft., and barely allowed the river to pass, although, of course, somewhat assisted by leakage.

It now only remained, to complete the dam, to close the openings. This was done in a manner that can be readily understood by reference to the cuts. Gates had been constructed with timber 10 in. thick, bolted together. They were hung on strong wooden hinges and, before being closed, laid back on the face of dam as shown at *B*, Figs. 1, 2 and 3. They were all closed in a short time on the afternoon of 9th November, 1881. To do this it was simply necessary to turn them over when the strong current through the sluices carried them into their places, as shown at *A*, Figs. 2 and 3, and by the dotted lines on Fig. 1. The closing was a delicate as well as dangerous operation, but was as successfully done as could be expected. No accident happened further than the displacement of two or three of the gates. The openings thus left were afterwards filled up with timber and brushwood. The large opening alongside of the slide was filled up by a crib built above and floated into place.

The design contemplates the filling up with stone and gravel on up-stream side of dam about the triangular space that would be formed by the production of the line of face of flat dam till it struck the rock. Part of that was done from the ice last winter; the balance is being put in this winter.

Observations last summer showed that the calculations as to the raising of the surface of the river were correct. When the depth on the crest was 2.50 feet the water at the foot of the Longue Sault was found to be 25 in. higher than if no dam existed. The intention was to raise it 24 in.

The timber slide was formed by binding parallel piers about 600 ft. long up and down stream, as shown on the map, and 28 ft. apart, with a timber bottom, the top of which at upper end is 3 ft. below the crest of dam. It has the necessary stop logs, with machinery to move them, to control the water. The approach is formed by detached piers, connected by guide booms, extending about half a mile up stream. See map.

Alongside of the south side of the slide a large bulkhead was built, 69 ft. wide, with a clear waterway of 60 ft. It was furnished with stop logs and machinery to handle them. When not further required, it was filled up by a crib as before mentioned.

The following table shows the materials used in the dam and slide and the cost:

	Timber cu. ft.	Iron lbs.	Stone filling. cu. yds.	Excavation. cu. yds.	Cost.
Temporary Works,	134,500	92,000	11,400	.....	$79,000
Permanent Dam..	205,000	439,600	24,000	6,500	151,000
Slide, including apparatus.....	296,500	156,400	32,800	.....	102,000
Total.....	636,000	687,000	68,200	6,500	$332,000

The above does not include cost of surveys, engineering or superintendence, which amounted to about ten per cent. of the above sum.

The construction of the dam and slide was ably superintended by Horace Merrill, Esq., late superintendent of the "Ottawa River Improvements," who has built nearly all the slides and other works on the Ottawa to facilitate the passage of its immense timber productions.

The contractors were the well-known firm of F. B. McNamee & Co., of Montreal, and the successful completion of the work was in a large degree due to the energy displayed by the working member of that firm—Mr. A. G. Nish, formerly engineer of the Montreal harbor.

THE CANAL.

The canal was formed by "fencing in" a portion of the river-bed by an embankment built about a hundred feet out from the north shore and deepening the intervening space where necessary. There are two locks—one placed a little above the foot of the rapid (see map), and the other at the end of the dam. Wooden piers are built at the upper and lower ends—the former being 800 ft. long, and the latter 300 ft.; both are about 29 ft. high and 35 ft. wide.

The embankment is built, as shown by the cross section, Fig. 6. On the canal side of it there is a wall of rubble masonry *F*, laid in hydraulic cement, connecting the two locks, and backed by a puddle-wall *E* three feet thick; next the river there is crib-work *G* from ten to twenty feet wide and the space between crib-work and puddle filled with earth. The outer slope is protected with riprap, composed of large boulders. This had to be made very strong to prevent the destruction of the bank by the immense masses of moving ice in spring.

The distance between the locks is 3,300 feet.

In building the embankment the crib-work was first put in and followed by a part (in width) of the earth-bank. From that to the shore temporary cross-dams were built at convenient distances apart and the space pumped out by sections, when the necessary excavation was done, and the walls and embankments completed. The earth was put down in layers of not more than a foot deep at a time, so that the bank, when completed, was solid. The water at site of it varied in depth from 15 feet at lower end to 2 feet at upper.

The locks are 200 ft. long in the clear between the gates, and 45 ft. wide in the chamber at the bottom. The walls of the lower one are 29 ft. high and of the upper one 31 ft. They are from 10 to 12 ft. thick at the bottom.

The locks are built similar to those on the new Lachine and Welland canals, of the very best cut stone masonry, laid in hydraulic cement. The gates are 24 in. thick, made of solid timber, somewhat similar to those in use on the St. Lawrence canals. They are suspended from anchors at the hollow quoins, and work very easily. The mitre sills are made of 26-in. square oak. The bottom of the lower lock is timbered throughout, but the upper one only at the recesses, the rock there being good.

The rise to be overcome by the two locks is 16 ft., but, except in medium water, is not equally distributed. In high water nearly the whole lift is on the upper lock, and in low water on the lower one. In the very lowest known stage of the river there will never be less than 9 ft. on the mitre sills.

As mentioned at the beginning of this article, four locks were required on the old military canal to accomplish what is now done by two.

The canal was opened in May, 1882, and has been a great success, the only drawback—although slight—being that in high water, the current for about three-quarters of a mile above the upper pier, and at what was formerly the Chûte à Blondeau, is rather strong. These difficulties can be easily overcome—the former by building an embankment from the pier to Brophy's Island and the latter by removing some of the natural dam of rock which once formed the "Chûte."

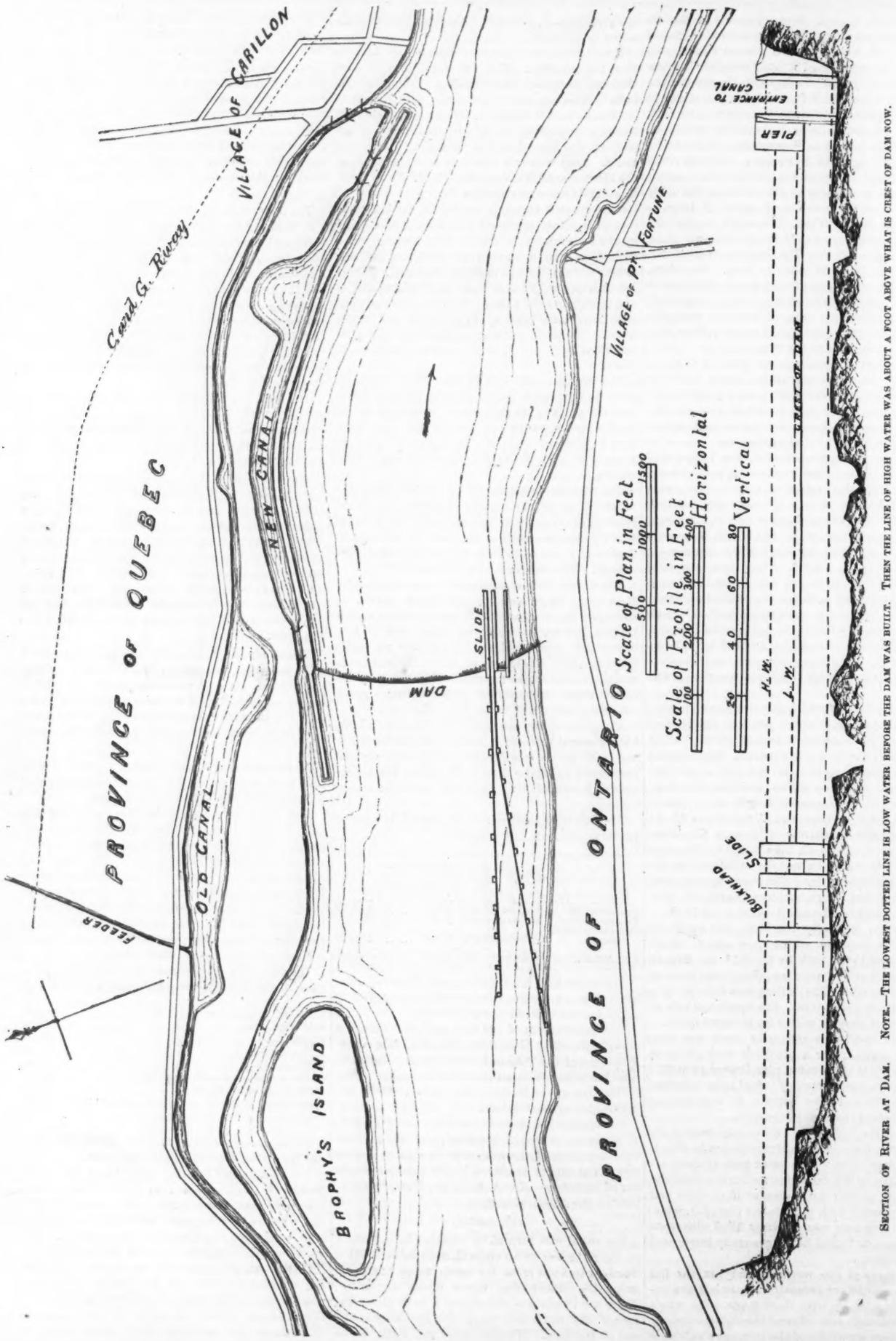
The following are, in round numbers, the quantities of the principal materials used:

Earth and Puddle in Embankment, cub. yds.	148,500
Rock excavation, "	38,000
Riprap, "	6,600
Lock masonry, "	14,200
Rubble masonry, "	16,600
Timber in cribs, lock-bottoms and gates "	368,000
Wrought and cast iron, lbs	173,000
Stone filling, cu. yds	45,300
Concrete, "	830

The total cost to date has been about $570,000, not including surveys, engineering, etc.

The contractors for the canal, locks, etc., were Messrs. R. P. Cooke & Co., of Brockville, Ont., who have built some large works in the States, and who are now engaged building other extensive works for the Canadian Government. The work here reflects great credit on their skill.

On the enlarged Grenville Canal, now approaching completion, there are five locks, taking the place of the seven small ones built by the Imperial Government. It will be opened for navigation all through in the spring of 1884, when steamers somewhat larger than the largest now navigating the St. Lawrence between Montreal and Hamilton, can pass up to Ottawa City.



SECTION OF RIVER AT DAM. NOTE.—THE LOWEST DOTTED LINE IS LOW WATER BEFORE THE DAM WAS BUILT. THEN THE LINE OF HIGH WATER WAS ABOUT A FOOT ABOVE WHAT IS CREST OF DAM NOW.

MAP OF OTTAWA RIVER AT CARILLON RAPIDS.

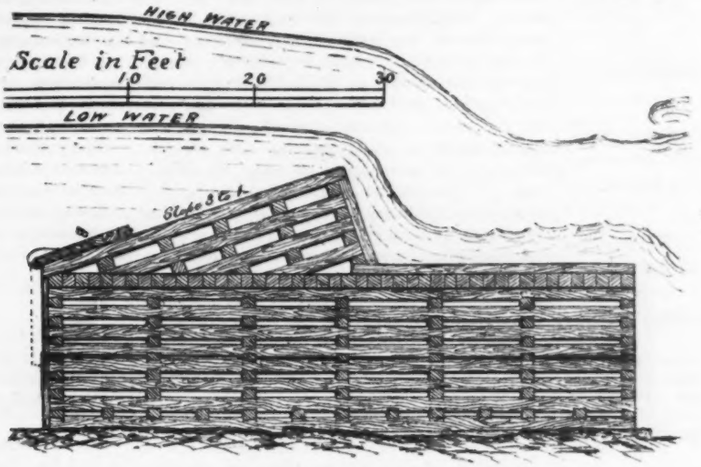


FIG. 1. CROSS SECTION IN DEEP WATER.

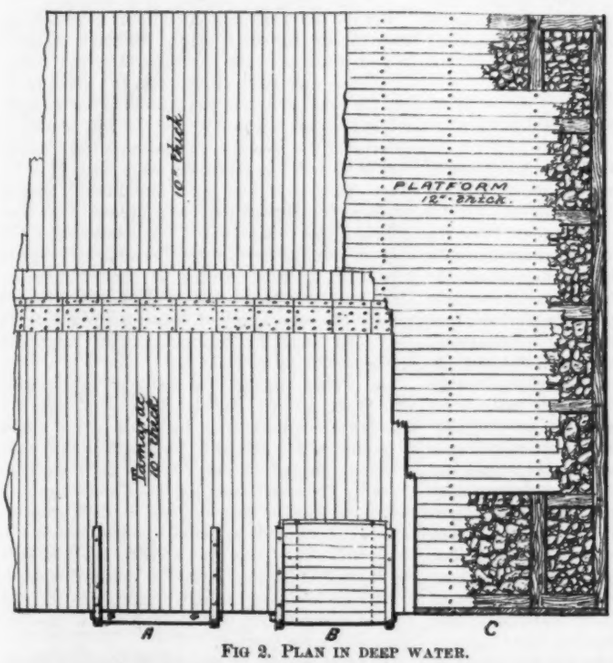
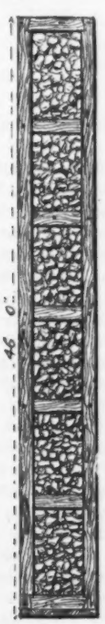
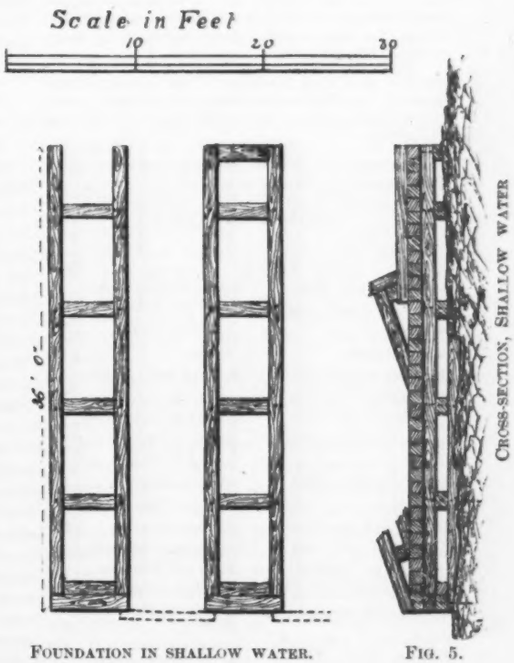


FIG 2. PLAN IN DEEP WATER.





FOUNDATION IN SHALLOW WATER.

FIG. 5.

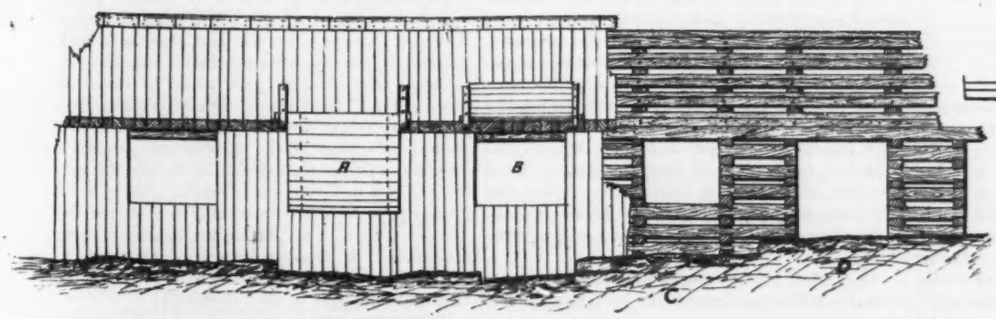


FIG. 3. ELEVATION IN DEEP WATER.

FIG. 4. ELEVATION OF FOUNDATION SHALLOW WATER

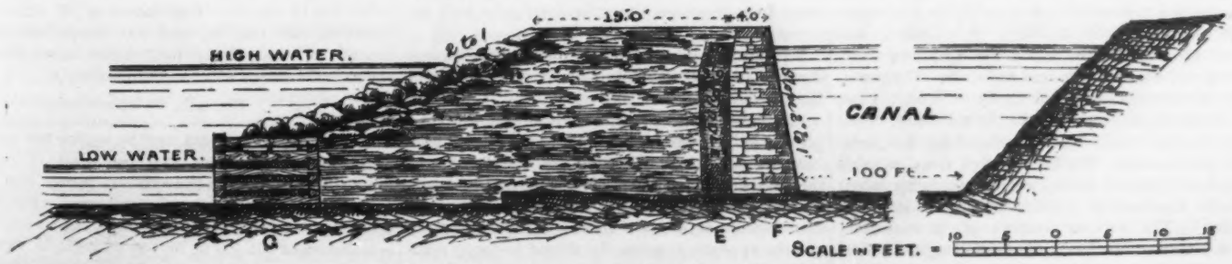


FIG. 6. SECTION THROUGH CANAL EMBANKMENT.

DETAILS OF DAM ACROSS OTTAWA RIVER.

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AND
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Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belong to the province of this Journal is solicited.

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THE ITALIAN CIVIL ENGINEERING SERVICE.

The Italian civil engineers form a government department, and have the charge of the public roads, the railways, drainage works, public buildings, etc. In every provincial capital there is a central office, on which local offices are dependent; and all are divided into inspection districts, to each of which an inspector is annually assigned. The supreme authority is vested in the Superior Council of Public Works, consisting of all the inspectors in active service, assisted by three especially distinguished engineers or architects. All projected public works have to be approved by this council before being sent on for the authorization of the Council of State. It is divided into three sections: roads and buildings; hydraulic, earth, and coast works, and railways. The members of each section consider only their own class of subjects, and can call in the assistance of engineers of the first class, who would for the occasion have a vote. The President of the Council is appointed for two years, and can be reappointed; but the Minister of Public Works presides when present. The service consists of 30 inspectors (first and second class), 100 chief engineers (first and second class), 420 ordinary engineers (first, second and third class), and 80 pupil engineers. A lower division is formed by 900 assistants (first, second, and third class), and 200 pupil assistants. There are also 250 clerks. Appointments are only made to the lowest class of each category, the rise from class to class being for four-fifths in order of seniority, and one-fifth in order of merit. But promotions to the rank of chief engineer or inspector are made only for merit. Eminent private engineers or architects may be admitted to the rank of chief engineers, in recognition of some remarkable work or distinguished merit. Youths who have obtained their diplomas in the colleges prescribed are eligible as pupil engineers. Half the appointments are given by open competitive examination, and half are divided among the affiliated schools, in proportion to their successes in the preceding year. The appointments to the lower grades are made solely by competitive examination, under certain conditions. Salaries are increased by one-tenth after every six years' service in the same class, until they become equal to those of the class above. This rule only applies to officers whose pay does not exceed 800 lire ($1,600) per annum. A fixed sum is allowed for traveling and office expenses, according to rank; and there are allowances for the expenses of temporary absence from home on Government business, and for compelled residence in exceptionally lonely and unhealthy situations.

EXHAUST STEAM FOR HEATING.

In a former article, published Feb. 3, the several purposes for which exhaust steam can be used were mentioned. It was also shown, that when it was used for heating the feed water, there is a limit to which back pressure in the engine, resulting from forcing the exhaust steam through the heater, is allowable. The results there given were based, however, on the hypothesis that the feed water was heated from freezing to boiling point. In actual practice, the range is much less, and the saving under the most favorable conditions rarely amounts to ten per cent. of the cost of coal.

In many establishments steam is generated for various purposes other than power, such as the heating of water, melting of fats, the drying and steaming of products, etc., as well as for ordinary heating, for which, if proper appliances were provided, the exhaust steam would be sufficient and its use, in place of live steam from the boiler, would reduce the necessary amount of boiler space and effect a greater saving in the consumption of coal than is possible to obtain by heating the feed water.

The actual quality of heat in a given *weight* of steam is very nearly the same at all pressures, and increases only slightly as the pressure increases. Therefore the amount of available heat in a pound of exhaust steam must be nearly as great as in a pound of steam taken directly from the boiler, at a higher pressure and temperature. Indeed it may with reason be claimed that there is more heat available, for heating at least, in steam of lower pressure, where the heat in the water of condensation is not utilized, owing to the greater amount of latent heat set free in the process of condensation.

To employ exhaust steam satisfactorily, however, the following facts must be taken into account:

First. The density of steam, or its weight per cubic foot, increases almost in direct ratio with the pressure; and,

Second. The heat radiated from a given surface diminishes with the reduction of temperature of the steam used.

Provision must be made, therefore, to supply a greater bulk of steam, by making the supply pipe larger than would be needed for live steam, and the heating surface must also be enlarged proportionately, more especially if the steam be used for the heating of rooms; all the distributing pipes and the apparatus generally should be made sufficiently large to prevent, as much as possible, a back pressure upon the engine.

It would also be advisable to connect the exhaust pipe with the boiler by a pipe, closed by an automatic valve, which will allow steam to enter the heating apparatus direct from the boiler when the engine is not in operation.

If these provisions are properly made, there is no reason why a system for heating by exhaust steam should not work as satisfactorily as one proportioned to heat with steam at a higher pressure.

Every steam engineer has some rule which he follows for determining the amount of heating surface necessary for the purpose of supplying a given quantity of heat, and works on steam heating give such rules, of which that of Tredgold may be taken in the following general form:

$$S = C\frac{(t' - t)}{(T - t')}$$

In which for a given example C is the value of the different constants, including the quantity of air to be heated.

t' is the temperature to which the room is to be kept.

T is the temperature of the steam pipes, assumed to be $\frac{1}{20}$ less than the temperature of the steam.

t is the external temperature.

S is the number of square feet of surface.

For the same external conditions, therefore, the only variable for steam used at different pressures is T, dependent on the temperature of the steam. If parties had been using steam at a given pressure for heating, and it was desired to use exhaust steam instead, it would be no difficult matter to determine the amount of heating surface necessary to be added to attain the same results as before. Thus, if it had been found that a heating surface of one square foot was necessary to heat 100 cubic feet to maintain a temperature of 70° in a given establishment, when the outside temperature is 10°, by using steam at 25 pounds pressure, then, according to the rule of Tredgold, it would require one square foot of heating surface to 70 cubic feet heated for the same external conditions when heating by steam at 212°.

The writer conducted a series of experiments two years ago which tended to show that the amount of heating surface for steam at 212° ought to be double that necessary for steam at 25 pounds pressure, instead of only 40 per cent. more, as given by Tredgold's rule; but they were made to determine another question, and enough observations were not made to enable this apparent fact to be proved. They, however, confirm the fact that the amount of heating surface is necessarily much greater for low than for high steam pressures, and it must be considered if it is intended to use exhaust steam for heating.

The ideal system of heating by exhaust steam would be one in which the steam from the engine is carried away so promptly that there is no back pressure on the piston greater than the atmospheric pressure, and then the gain would be the entire heating done. Such a condition is very difficult—in fact impossible—to attain, as a certain amount of pressure in excess of the atmospheric pressure is necessary to drive the exhaust steam into the open air, and if it be forced into a heating system, a still greater pressure will be necessary to overcome the additional friction in passing through the heating apparatus. It is desirable to know the limits in which, notwithstanding such a back pressure, the exhaust steam may be used profitably.

If we assume such conditions, that 2½ pounds of steam per hour are necessary to maintain 1,000 cubic feet of air at a temperature of 70°, then the following rule can be used for determining the amount of back pressure in an engine below which the exhaust steam will be used profitably:

$$\textit{Back Pr.} = \frac{\text{No. cub. ft. space heated}}{\text{Cub. ft. steam used in engine per hour.}}$$

This simple rule shows that the limit of back pressure within which the exhaust steam can be used profitably for heating is very great when the space heated is considerable; thus, supposing an establishment 50×100 ft. and 50 ft. high, in which there is an engine used with cylinder 12×20 inches, running at a speed of 100 revolutions per minute, if the exhaust steam from this engine were used for heating, with a back pressure less

than 16 pounds, it is safe to assume, that using the exhaust steam in that manner would be more economical than to remove the back pressure and use live steam from the boiler.

In very cold weather the allowable back pressure will be greater than given by this rule and in moderate weather probably less.

To facilitate the flow of steam in the heating apparatus, it would also be well to increase the heating surface by increasing the diameter of the heating pipes, rather than by increasing their number, because of the greater reduction of friction thus obtained.

TO WHOM IT MAY CONCERN.

We are almost daily compelled to refuse applications for certain numbers of ENGINEERING NEWS for 1883, containing some special data of value to the applicant. Excepting only a limited supply of full files, which it is our practice to keep for new subscribers, the weekly editions for the present year are about exhausted, and we will not break our files to meet this scattered demand.

To these correspondents, our advice, mercenary though it may seem, is: to subscribe for the paper yourself, and cease to depend upon your neighbor's copy for any special information that you may want, with the expectation that you can at any time buy the needed number. We warn you that when wanted, it cannot be had, and before the year is out we confidently expect that you will have occasion for very much that can only be found within our pages.

It is one of the disadvantages against which a class paper has to struggle, that where a number of that class are gathered together one will subscribe and all his associates read that one paper. But we have made a new departure in the NEWS, and from our correspondence have every reason to believe that the above conditions, as far as the paper is concerned, are changed. One copy in an office will no longer answer for the number who wish to preserve it for the sake of plans or information that may be useful in the near future. It is from these non-subscribers that comes the present demand for odd numbers of the journal, and it is to this class that our advice applies.

Within the year 1883 we hope to give the readers of the NEWS such a series of illustrated papers upon engineering appliances as would in itself be an ample return for the annual subscription. As yet we are but fairly launched upon this subject, and any engineer who has had occasion to hunt up a similar matter will appreciate the time and labor necessarily consumed. The data is as yet unrecorded; it cannot be found by leafing over engineering publications; but the raw material must be sought for along the highways of the land, on our public works, our wharves and docks, and by interviews with the horny-fisted but shrewd and intelligent "boss," who is often a depositary of gems of practical experience, that the average engineer has never dreamed of in his philosophy.

Our readers can assist us greatly in this effort to do good to the many, for each one of them has knowledge that if put upon record might help his fellow-practitioner. We will give the space and printers' ink required to publish all that is generally useful.

PERSONAL.

HENRY M. WIGHTMAN has been unanimously re-elected city engineer of Boston.

J. L. P. O'HANLEY has been appointed chief engineer of the Ontario Pacific Railroad. Headquarters at Cornwall, Ont.

M. DE LESSEPS has embarked from Marseillles for Tunis to direct surveys in connection with the project to convert the Desert of Sahara into an inland sea.

FRANK H. POND, proprietor of the Pond Engineering Co., announces, March 1st, that "having his day closed my business relations with the firm of Henry R. Worthington, as their Western representative at St. Louis, which position I have held for the past four years, I take this opportunity to announce that I have accepted the agency for the pumping machinery manufactured by the Geo. F. Blake Manufacturing Company, with office at 709 Market st., St. Louis, Mo.; and branch offices at 130 W. Second st., Cincinnati, O., and 88 Market st., Chicago, Ill.

MR. RICHARD M. BOLLING has resigned the position of Assistant City Engineer of Richmond Va., to accept a more lucrative position at Roanoke, Va. He has been appointed by a company there agent for the sale of real estate in that growing town in connection with his own business as civil engineer.

MAJOR WILLIAM LUDLOW, the recently elected Chief Engineer of the Philadelphia Water Department, has been granted, by the Secretary of War, a leave of absence of two years from duty as Engineer Secretary of the Lighthouse Board. His successor in the Engineer Corps will be MAJOR DAVID P. HEAP.

ED. D. MUHLENBERG, C.E., formerly Captain of the 4th Artillery, U. S. A., died at Lancaster, Penn., March 10th, aged 51 years. He graduated at Yale College in 1850, and was first connected with the Reading Railroad Company as an engineer, he subsequently went to Brazil as an engineer and contractor, but returned at the outbreak of the war of 1861, and was commissioned a lieutenant in the 4th Artillery, and served throughout the war. At the close of the war he resigned and resumed his profession, being engaged on the Union Pacific and North Pacific Railroads; his last service with the Southern Pacific Railroad.

Intelligence of the death of Chief Engineer WILLIAM H. KING, United States Navy, at San Francisco, has been received by the Department at Washington. Chief Engineer King was a native of North Carolina, and was appointed Third Assistant Engineer May 20, 1857. He served until 1860 off the coast of Africa. At the breaking out of the war he was transferred to the West Gulf squadron and promoted to the rank of Second Assistant Engineer. The following year he was advanced to the rank of First Assistant Engineer, in which capacity he served the Government until 1863, when he was promoted to the rank of Chief Engineer. At the close of the rebellion he was transferred to the Pacific squadron. In 1869 he served in the Navy-yard at Washington for a short time only, being transferred to the Asiatic fleet, where he was on duty until 1872, when he was appointed Inspector of Machinery afloat at Washington. In 1874 he joined the North Atlantic station on board the iron-clad Dictator, and remained at that post until 1877. At the time of his death he was stationed in Alaska. He was in the third class of Chief Engineers, and had the relative rank of Lieutenant-Commander.—*N. Y. Times, March* 13.

ANDREW BELL, C. E., whose very interesting and valuable description of the great Ottawa River dam, and other works, at Carillon, Canada, we publish this week, is a graduate of Queen's University, Kingston, Ont. He commenced his engineering experience in the following year as a rodman on the Brockville & Ottawa Railway, now the Eastern Division of the Canada Pacific Railway, and it was at this time that the writer made his acquaintance, together with that of the other engineers of the same corps; an acquaintance which finally led to our entering the engineering class of McGill University some years later, and, ultimately, venturing upon engineering journalism. Mr. BELL made survey for a proposed canal from Toronto to Georgian Bay, in 1855-56, and afterwards remained on the B. & O. R. R. till 1859 as Assistant Engineer. In 1863, we met Mr. BELL in Toronto on a like mission as our own—to undergo an examination before the Government Board of Examiners for the diploma of Provincial Land Surveyor. Although Mr. BELL was acknowledged as a skillful civil engineer and land surveyor, of many years' experience, and had complied with all the requirements of the Act, except actual residence with the land surveyor to whom he had been "apprenticed," he was not allowed to enter for examination at all, mainly through the petty spite of the martinet of the Board—a fellow by the name of Passmore. When it is understood that this involved a set-back of three years' time, coupled with an apprenticeship to some man, inferior in ability every way, to whom not only services had to be rendered free, but to whom frequently a premium had to be paid, it will be understood how keen is the chagrin of such an occurrence. We had already suffered it, the same evil genius having decided that the months of a college vacation did not count, and so we had to go back and spend a whole year's apprenticeship, in which we paid a premium and gave our services free. It is one of the bitter experiences of our professional life that has been recalled by Mr. BELL'S experience, and we must be excused from getting out of temper when we think of it.

Mr. BELL was the engineer-architect of the great woolen mills at Almonte and Cornwall, Canada, and between 1866 and 1869 was engaged in the construction of these works, besides being retained on numerous other engineering works. In 1869 he was sent by the American government to make some surveys in the Northwest, and in 1870 he was appointed resident engineer of the Grenville Canal; in 1872 he was appointed to the same office on the present work, where he has been ever since. He has collected a vast fund of information upon the hydraulics of the great Ottawa River, and in his experience as an expert constructor of mills, mill dams, and the larger dams connected with his canal building experience he may well be ranked among the foremost hydraulic engineers in America. Like many other capable men in his profession he is hardly known beyond the precincts of his office, and hence it is that we are pleased to introduce him as one of the oldest and ablest of our own engineering friends.

Dr. ROBERT BELL, of the Dominion Geological Survey, and the originator by exploration of the Hudson Bay scheme of a route to the Northwest, which is attracting a good deal of attention now, is a younger brother of the subject of the above sketch. The family is one of the oldest and best known in the Dominion and for many years furnished a representative on the reform side to the Canadian Parliament.

ELECTIONS AND APPOINTMENTS.

President FRANKLIN GOWEN of the Philadelphia and Reading Railroad has issued the following circular: "Subject to the following changes, all officers, agents and employés of the receivers are retained in the service of the company. Mr. GEO. DE B. KEIM is appointed Vice-President of the company and relieved of the duties of general solicitor. Mr. GEORGE R. KAERCHER is appointed general solicitor of the company. He will report to the vice-president. His office will be at the general office of the company. The chief engineer is relieved of the charge of maintaining and repairing the railroads and property of the company. He will retain, however, the control of the location, construction and erection of all new work and will act as consulting engineer of permanent way and structures. Mr. WM. H. BINES is appointed assistant chief engineer, and will perform such duties as may be assigned him by the chief engineer. Mr. HENRY K. NICHOLS is appointed chief road master. He will have charge of maintaining and repairing all the railroads and appurtenant structures of the company, and have control of all roadway, yards and shops. All resident engineers will report to him. He will report to the general manager, but will consult with the chief engineer upon all professional engineering questions. The locomotive and car shops, the foundry, forge and appurtenant shops at Reading are hereby transferred to the Philadelphia & Reading Coal and Iron Company, and all persons employed in and about such shops are hereby transferred to the service of the latter company. Mr. L. B. PAXON is retained in the service of the company as en-

gineer of machinery. He will have charge of maintaining and repairing the locomotives and stationery machinery of the company, will have supervision of all the repair shops in the transportation department, excluding those transferred to the Philadelphia & Reading Coal and Iron Company, as above, and such other duties as may be assigned him by the general manager, to whom he will report. The superintendent of steam colliers will report hereafter to the general manager. The real estate agent will report to the vice-president. Subject to the orders and control of the president, the executive duties of the company will be divided among the vice-president, general manager and general traffic manager as follows: The vice-president will have charge of the legal and financial questions, of the anthracite coal trade, and of all matters pertaining to the real estate of the company other than that occupied for railroad or canal purposes. The general manager will have control of all questions involving the movement of traffic by the company as a transporter by rail or on water, and of maintaining and repairing the railroads, canals, and property of the company. The general traffic manager will have charge of all freight and station agents, of making rates for tolls and transportation and of all commercial questions pertaining to the interchange of traffic with other compaines and transporters. He will report to the president."

AN EASY METHOD OF COMPUTING THE MOMENTS OF INERTIA OF I BEAMS AND CHANNEL BARS.

[Written for Engineering News.]

BY J. C. BLAND., ASST. ENGR. PHILADELPHIA BRIDGE WORKS.

The moment of resistance to flexure of a symmetrically shaped beam is given by the expression

$$M_0 = \frac{2fI}{h} \qquad (1)$$

where

M_0 = the greatest bending moment due to external forces (in inch tons).

f = maximum fibre stress (in tons per square inch).

I = moment of inertia of the section.

h = height of beam in inches.

The ratio $\frac{2I}{h}$ varies for each beam, and has been called the modulus of the section, for when multiplied by the fibre stress we have the moment of resistance.

From the expression, given by Rankine in his "Civil Engineering," page 294,

$q = \frac{I}{m' h^2 S}$ we get for a symmetrically shaped beam, $m' = \frac{1}{4}$, whence

$$q = \frac{2I}{h^2 S}$$

$$\text{or } qhS = \frac{2I}{h} \qquad (2)$$

multiplying both sides of equation (2) by f, we obtain

$$qfhS = f.\frac{2I}{h} = M_0. \qquad (3)$$

whence, knowing the value of q, we can easily compute the strenth of a beam.

From (2) we find

$$q\frac{h^2 S}{2} = I \qquad (4)$$

Now if the value of the constant q be known the moment of inertia can be expressed in terms of the height and area of the beam. From an accurate computation of a series of I beams varying from 15 in. I 200 lbs. per yard to 4 in. I 18 lbs. per yard, the value of q, for the standard or minimum roll of each beam has been found to vary but little from 0.33, and for the heavier weights of each shape to be 0.30.

For channels, running from 12 in. 150 lbs. per yard to 4 in. 15 lbs. per yard, the value of q is found to be about 0.28 for the standard section of each channel, while the heavier roll of each channel has q = about 0.25.

Thus:

I beams, minimum or standard weight, $q = 0.33$.

" maximum weight, $q = 0.30$.

Channel bars, minimum or standard weight, $q = 0.28$.

Channel bars, maximum weight, $q = 0.25$.

Substituting these values of q in (4) we get:

I beams, minimum or standard weight, $I = 0.165\ h^2 S$.

I beams, maximum weight, $I = 0.150\ h^2 S$.

Channel bars, minimum or standard weight, $I = 0.14\ h^2 S$.

Channel bars, maximum weight, $I = 0.125\ h^2 S$.

For example, take an 8-in. I beam, 65 lbs. per yard, what is the moment of inertia?

We have $I = 0.165 \times 8^2 \times 6.5$ sq. in. $= 68.64$.

The Union Iron Mills handbook gives for an 8-in. I beam, 66 lbs. per yard, 3.81 in. width of flange, 0.31 in. thickness of web, $I = 69.9$.

The New Jersey Steel and Iron Company's handbook gives for an 8-in. I Beam, 65 lbs. per yard, 4-in. flange, 0.3-in. web, $I = 67.4$.

The average value of I from these handbooks $= 68.65$. The above formula gives us the same value. We see then that our formula gives a value which differs from the two values given, by an amount only one-half that by which they differ from one another.

Consider a 10½ in. heavy beam 135 lbs. per yard, the formula $I = 0.15\ h^2 S$ becomes $0.15 \times 10\frac{1}{2}^2 \times 13.5$ sq. in. $= 213.26$. The Union Iron Mills handbook has for a 10½ in. I, 135 lbs. per yard, flange 4.92 in., web 0.79 in., $I = 201.0$.

The New Jersey Steel and Iron Co.'s handbook has for a 10½ in. I beam, 135 lbs. per yard, flange 5 in., web 0.47 in., $I = 233.7$.

The mean of these two values of I is 217.35, the formula giving $I = 213.26$.

With regard to channels. Take a 10-in. channel, 60 lbs. per yard. The formula $I = 0.14\ h^2 S$ gives $0.14 \times 10^2 \times 6.0$ sq. in. $= 84.0$.

Union Iron Mills, 10 in. channel, 60 lbs., 2.56-in. flange, .305-in. web, $I = 89.4$.

N. J. Steel and Iron Co., 10½-in. channel, 60 lbs., 2.75-in. flange, .375-in. web, $I = 88.4$.

The latter company has no 10-in. channel shape.

Now take a "Heavy" shape of channel, say an 8-in. channel, 48 lbs. per yard. The formula $I = 0.125\ h^2 S$ gives $0.125 \times 6^2 \times 4.8 = 21.6$.

Union Iron Mills, 8 in. channel, 48 lbs., flange 2.28 in., web .527 in., $I = 22.0$.

N. J. Steel and Iron Co., 8 in. channel, 45 lbs., flange 2.5 in., web 0.4 in., $I = 21.7$.

It seems then that the values of q as given are sufficiently close for all ordinary purposes.

We have simply to recollect the values of q, viz., 0.33 for beams and 0.28 for channels. The heavier rolls of these shapes can be taken as having $q = 90$ per cent. of the standard values, viz., $.33 \times .9 = .297$, say 0.3 for I beams, and $0.28 \times .9 = 0.252$, say 0.25, for channels.

Having shown that our values of the constant q are sufficiently accurate for practical purposes, we can now easily compute the strength of a beam. From equation (3) we have $M_0 = qfhS$. Now what is the capacity of an 8-in. I beam, 65 lbs. per yard, subjected to a uniformly distributed load, the fibre stress to be 6.0 tons per square inch. If W be the uniformly distributed load, and l the span in feet, then the moment in inch tons is

$$M_0 = \frac{W\ 12\ l}{8} = \tfrac{3}{2}\ Wl.$$

Whence we must have $\frac{3}{2}\ Wl = qfhS$ or

$$W = \tfrac{2}{3}\ q\frac{fhS}{l}. \qquad (5)$$

Suppose our span $= 10$ ft., then

$$W = \tfrac{2}{3}\left[\frac{0.33 \times 6.0\ \text{T} \times 8\ \text{in.} \times 6.5\ \text{sq. in.}}{10}\right] = 6.864\ \text{tons.}$$

For this beam the Union Iron Mills give $W = 7.00$ tons, the New Jersey Steel and Iron Co. give $W = 6.64 + 0.11 = 6.75$ tons, the Phœnix Iron Co. give $W = 7.4$ tons.

Or we could compute the value of I as has been explained, and use formula (1), viz.:

$$M_0 = \frac{2f\,I.}{h} \quad \text{But we have shown}$$

that $M_0 = \frac{3}{2}Wl$, whence,

$$\tfrac{3}{2}Wl = \frac{2f\,I.}{h}$$

or

$$W = \tfrac{4}{3}\frac{f\,I}{h\,l} \qquad (6)$$

Thus for the same beams, I has been shown to be 68.64, then

$$W = \frac{4 \times 6 \times 68.64}{3 \times 8 \times 10} = 6.864\ \text{tons.}$$

From (6), by transposition of terms, we get

$$f = \frac{3\ W\,h\,l}{4\,I}. \qquad (7)$$

Hence, we can find the fibre stress for a given load W, and span l. Thus take $W = 4.0$ tons, span $= 10$ ft. What is the fibre stress in an 8-in. I, 65 lbs. per yard?

We have shown $I = 68.64$.

$$\text{Then } f = \frac{3 \times 4.0 \times 8 \times 10}{4 \times 68.64} = 3.49\ \text{tons per square inch.}$$

Suppose we wish to find the proper beam to use in order to carry a given load W uniformly distributed in a span of l ft.

From (5) we get

$$\frac{3\ W\,l}{f} = 2qhS \qquad (8)$$

For example: Suppose our load is 8 tons uniformly distributed, and the span is 12 ft.

Substitute these in (8) and we get

$$\frac{3 \times 8.0 \times 12}{f} = 2qhS$$

$$\text{or } 144\frac{}{f} = qhS.$$

Now if we wish a fibre stress of 4 tons per square inch the above would become

$$36 = qhS.$$

$$\text{or } S = \frac{36}{qh}$$

Dividing this by 0.3 as the value of q

$$S = \frac{120}{h}$$

whence if $h = 10\frac{1}{2}$ in., $S = 11.4$ sq. in.

That is, a 10½-in. I beam, 114 lbs. per yard, would answer.

This being close to the light weight of a 10½ in. I beam, $q = 0.33$ would have been a more proper value to take.

Then

$$S = \frac{36}{0.33 \times 10\frac{1}{2}} = \text{say } 10.4\ \text{in.}$$

Thus a 10½-in. I beam, 105 lbs. per yard, would be the beam to use.

Now, referring to the Phœnix Co.'s tables, we find for a 12 ft.-span, 10½-in. I, 105 lbs. per yard, fibre stress of 6.0 tons, the safe load to be 12.9 tons; but since our fibre stress is 4.0 tons, then $\frac{4}{6} \times 12.9$ tons $= 8.60$ tons. This load would be the safe load for the Phœnix shape when fibre stress was limited to 4.0 tons per square inch.

The New Jersey Steel and Iron Co.'s Tables give for the same size and weight of beams a safe load of 11.71 + 420 lbs. = 11.92 tons, the fibre stress also being 6.0 tons. Two-thirds of this, or say 8.0 tons, would be the safe load at 4 tons fibre stress.

In fact it should be observed that when beams and channels have their strength computed by means of the handbooks, it does not follow that the shapes are bought from the company whose handbook is used. And it has already been shown that the difference in the values of shapes of the same depth and weight coming from different companies is much greater than the difference between results by this method and any one of them.

This method certainly commends itself from the one fact alone, that it does not need the pocket-book of the iron company always at hand.

The elementary formula and the values of the constant q for beams and channels are the chief things to be remembered—the "run" of the weights and sizes of shapes in general use is the alphabet of the subject.

ADDITIONAL WATER SUPPLY FOR NEW YORK.

The following is the report of the Water Commission appointed by Mayor Edson at the request of the State Senate. The Commission was formed to examine the plan prepared by the Chief Engineer of the Croton Aqueduct, and other engineers, for a new aqueduct and additional storage capacity for Croton water, and to report on the probable cost, the time required for the execution of the work, etc.:

We have performed the duty assigned to us to the best of our ability in the time allowed. We have held thirty-three meetings and have had before us eminent engineers, possessing experience and knowledge respecting the water supply of this and other cities, and we have been greatly aided by the engineers at present in charge of the Croton Aqueduct and water supply of the City of New York; we have also preserved full stenographic reports of the information received from these engineers, and of all other evidence presented to the committee. We have visited and examined the present Croton dam and the site of the proposed new dam at Quaker Bridge, and also the site of the proposed dams at or near Brewster's Station, Putnam County.

We are of opinion, as well from our own observation and knowledge as from the statements made before us, that the health, security and growth of this city imperatively require an increased supply of pure and wholesome water, and that such measures should be immediately taken by the Legislature as will enable the city to secure and provide such increased and sufficient supply at the earliest day practicable. We have considered all the sources that have been suggested from which to obtain increased water supply. We have also considered the introduction of salt water for cleaning the streets, gutters and sewers, and for extinguishing fires.

The introduction of salt water would require a double system of pipes both in the streets and in all buildings into which it should be carried. The amount of water used in extinguishing fires in an entire year is less than one-half of one day's consumption for other purposes. These facts seem to

us decisive against the introduction of salt water so long as an adequate supply of fresh water is obtainable at reasonable cost.

THE CROTON WATER-SHED THE BEST SOURCE OF SUPPLY.

The evidence before us leaves no doubt that the Croton water-shed is the best source from which to obtain an increased supply of water, or that the yield of water from this source will be adequate to meet the wants of the city for at least twenty-five years, or until the consumption of water by the city shall exceed 250,000,000 gallons per day. This water-shed is within the jurisdiction of our own State; it has been more carefully studied, and is better known than any other; its water is pure and wholesome, and a supply for a consumption up to 250,000,000 gallons per day can be obtained at less expense from this than from any other source.

This aqueduct is built for about six miles of its length upon a foundation of stone laid dry without mortar; where so built in soft or swampy ground the aqueduct has settled from eight to twelve in., and at several such points has become cracked enough to leak badly. The leaks have, however, been carefully repaired and the aqueduct is now in condition, with proper care, to deliver 95 to 98 million gallons per day, which it has done since 1874. It cannot, as we believe, be safely relied on to deliver more.

When the aqueduct was built the population of our city was less than 350,000; it is now over 1,300,000. This great increase in population, together with the great and increasing demand for water by the rapidly growing manufactures of the city, has so greatly increased the consumption of water that in many parts of the city where formerly the water was delivered on the highest floors of buildings it will now run only on the lower floors, and sometimes only in the basements and cellars.

A NEW AQUEDUCT NEEDED.

We are of the unanimous opinion that a new aqueduct should be built immediately; that it should be large enough to carry all the available water in the Croton water-shed and, together with the existing aqueduct, any additional supply which the city may hereafter secure in that direction from other sources. In order to do this the aqueduct should, in our judgment, be not less than fifteen feet in clear inside diameter. A conduit of this diameter will not cost more than fifteen per cent. above the cost of one twelve feet in diameter, and will have a capacity greater by two-thirds. This conduit should, when practicable, be built in rock tunnel as proposed by the Chief Engineer.

Its length, if built from the proposed dam at Quaker Bridge to Sedgwick ave,, will be twenty-six and one-half miles, or, if built from the Croton Lake to the same point, will be twenty-seven and three-quarter miles. From the evidence before us we believe that such an aqueduct, namely, fifteen feet in clear inside diameter, lined with twelve inches of brick, can be built at a cost not exceeding $500,000 per mile, providing the work be done with the attention, energy and economy with which it would be done by private parties. It is also our opinion that this aqueduct can be built within two and one-half years from its commencement, either from the proposed dam at Quaker Bridge to Sedgwick ave., or from the Croton Lake to the same point.

PLANS FOR THE STORAGE OF WATER.

The statistics of rain-fall in the Croton water-shed, in connection with the ascertained flow of the river at Croton dam,show that this water-shed is capable of furnishing at least 250,000,000 gallons per day. From the nature of the Croton water-shed the flow of the Croton River is extremely variable, varying from about 10,000,000 to 2,000,000,000 gallons per day, and in order to secure a constant supply at all times it is necessary to impound this water in reservoirs located in the Croton water-shed or elsewhere on the line of the aqueduct. At present there are storage reservoirs as follows: Boyd's Corner, Middle Branch, Lake Mahopac and other small lakes, representing in all a total capacity of 8,586,000 gallons, as by report of the Chief Engineer.

For such years of drought as 1880 and 1881, in order to be certain of a supply of one hundred million gallons of water per day, it is believed that, in accordance with the plans of the Department of Public Works already made, additional storage reservoirs, of a capacity of at least four thousand million gallons, should be built at once. As the city increases in population and manufactures, a supply of one hundred million gallons per day will be not be sufficient, and it is deemed advisable that further provisions should be made, either now or as fast as the same shall be needed, for a storage of such a quantity of water in the Croton water-shed as will secure all the available water therefrom.

We have considered two plans for storage of water, not entirely different, but of which one may serve to supplement the other. By one of these plans a very large reservoir (3,685 acres, including the present Croton Lake), known as the Quaker Bridge Reservoir, and of capacity to impound thirty-two thousand million gallons of available water, is proposed very low down in the Croton Valley. By the other plan, smaller reservoirs are proposed on the Croton River and its main branches at and above the present Croton Dam. If the first plan is adopted, it is deemed advisable to build one of these smaller reservoirs near Brewster's Station, to be used as an auxiliary to either large reservoir. We have examined these places, and the storage capacity of the different reservoirs, and also the plans and estimates for the dam at Quaker Bridge. The estimates for the work at Quaker Bridge and the surveys seem to have been very carefully prepared.

THE PROPOSED QUAKER BRIDGE DAM.

The plan referred to in the resolution of your honorable body contemplates the construction of this dam at Quaker Bridge, which, when completed, would be the largest work of the kind in the world. From the evidence of engineers and contractors we unanimously conclude that this structure is practicable, provided it be built on solid rock with a width at the bottom quite equal to its height; that it can be built for a sum within $5,000,000, if the same conditions are observed in its construction as we have indicated respecting the construction of the aqueduct; that under such conditions it can be built within five and one-half years from the commencement of the work; and that it can be made safe, durable and sufficient for the purpose for which it is designed

We are divided in opinion as to whether this Quaker Bridge Dam should be built, or separate dams for storing water in the Croton basin at and above Croton Dam, containing the plan hitherto adopted, or elsewhere in the line of the aqueduct; and also as to whether, in case the Quaker Bridge Dam be built, any additional reservoirs should be built besides the one already indicated near Brewster's Station.

A COMMISSION AND CONTRACT WORK INSISTED ON.

We regard this question as one of very great importance, and we recommend that it be referred to an unprejudiced commission, which shall be appointed in such a manner as to secure the greatest impartiality, and which shall have charge of the construction of the work. The decision of this question should depend in great measure upon the healthfulness of the water to be impounded and supplied by the two plans, upon the time it will take to build the several dams, upon the time within which a sufficient supply of water will be furnished to the city by each, upon the comparative ultimate cost to the city of the two plans, and upon such other considerations as shall properly bear upon the question, This commission should afford free and just opportunity for hearing and producing testimony, and for the examination of witnesses.

We are unable to recommend whether the water from Sedgwick avenue across Harlem River should be carried over High Bridge or other bridges, or under the river. The data before us in regard to the nature of the ground, whether rock or otherwise, and also in regard to the ability of the bridge to carry the additional weight, are insufficient to enable us to form an opinion. This is in great measure a question of the cost of the two plans. We are, however, of opinion that, if building a tunnel under the river will delay materially an increased supply of water to the city, High Bridge or other bridges should be utilized to prevent such delay so far as this can be done with safety.

The prices named for the work do not include land damages or other damages of any kind, or any excavations or other work which may become necessary, elsewhere than at Quaker Bridge Dam, in preparing the proposed lake for a proper storage basin. The prices are believed to be adequate prices at which the work estimated will pay a fair profit, and when proposals are asked it is believed that proposals to do the work, in the manner herein suggested, by responsible contractors, will be lower than those named.

In our opinion this work should be done only by competent and reliable contractors, as far as practicable, who should be required to give ample security by bond for the completion of the work both according to specifications and within the time which shall be agreed upon, to the end that the work shall be done in the best and most reliable manner and in the shortest time practicable. Everything is based upon the work being done under the direction of a commission removed from partisan influences and from the vexations and extortions which often surround public work. If this aqueduct and the proposed Quaker Bridge Dam are to be built by any other method than that herein suggested, we are unable to make any approximate estimate of the cost, or of the time time required for the completion of the work. It is earnestly hoped that this work shall be done by a commission selected from our best citizens, and that it may be done—as the existing Croton Aqueduct and other works connected therewith were done—in a manner to reflect credit upon the city and honor upon those having charge of the work.

SUGGESTIONS AFFECTING THE PRESENT SUPPLY.

From the evidence before us there can be no question that there is a great waste of Croton water in this city. It is only necessary to state the number of gallons daily delivered to the city to be convinced of this fact. It will take several years by any plan to increase the supply of water from the Croton water-shed; meanwhile the health, security, and necessary wants of the city require that until an additional supply be delivered waste should be prevented; waste of water at this time by any citizen in disregard of the convenience, happiness and health of his fellow-citizens is almost criminal. We recommend that all necessary powers be given to the Department of Public Works to prevent all reckless and unnecessary waste of water until an increased supply be delivered to the city, and that this department be directed to use such powers effectively to this end.

We would respectfully call the attention of your honorable body to the importance of restoring the 42d street reservoir to a condition of usefulness and efficiency, and of so maintaining it until some other adequate means of securing a pressure of water in the lower part of the city shall be provided. We are informed by the engineers of the Croton aqueduct that for a sum not exceeding $5,000 the connections of this reservoir with the several mains can be restored, and that by a slight rearrangement of connections in the pipes the whole force of the reservoir can be quickly directed upon any part of the city below it where a fire may occur. In order that this may be accomplished with the least possible delay, we earnestly recommend the repeal of the law which provides for its removal. To this end we have caused to be prepared and forwarded for the consideration of the Legislature a bill which it is believed will accomplish the desired object, and upon which we respectfully ask early and favorable action.

Respectfully submitted.

FRANKLIN EDSON,
WILLIAM DOWD,
JOHN T. AGNEW,
O. B. POTTER,
AMOS F. ENO,
HUGH N. CAMP.

PROPOSALS FOR PRINCETON, N. J., WATER-WORKS.

RECEIVED FEB. 27, 1883.

I. Well 25 ft. in diameter, 18 ft. deep through saturated gravel. Brick-work to be 24 ft. high and floored over, partly with iron beams and brick arches and partly with pine flooring.

Brick engine-house circular, on well, single story, conical roof. Frame boiler-house, chimney 40 ft. high. Stone foundation for tower 100 c. f., on hill, 6,000 ft. from well.

Condon & Rehill	$5,700.00
J. T. Rowland	6,184.00
E. H Fairchild	7,355.30
D. H. Valentine	8,388.00
J. J. Newman	9,400.00

Awarded to Condon & Rehill, Jersey City.

II. Pipe laying, 9,560 ft. 10 in.; 2,850 ft. 6 in.; 5,620 ft. 4 in., 10 fire hydrants, sitting stop-cocks, etc.

Adams & Foster	$6,649.00
J. J. Newman	6,921.00
J. J. Cogan	7,374.45
Henry Lewis	7,464 40
D. H. Valentine	7,535.80
Everson & Crane	7,555.10
E. H. Fairchild	8,207.35
S. Trumbore	8,740.10
J. T. Rowland	9,107.80
Condon & Rehill	11,045.90

Awarded to Adams & Foster, Pottsville, Pa.

SPECIFICATIONS FOR LAYING ASPHALTUM PAVEMENTS, 1882.

(*Continued from page* 118.)

1. Asphaltum pavements will be 2½ inches in thickness when compressed, with a base of hydraulic cement-concrete 6 inches in depth.

2. The sand beneath the present wood-pavement, and all other material necessary to be removed, will be removed from the street; soft or spongy places, not affording a firm foundation, will be dug out and refilled with good earth, well rammed, and the entire road-bed will be thoroughly rolled with a heavy steam-roller.

Upon the foundation as above described will be laid a bed of hydraulic cement-concrete 6 inches in thickness, to be made as follows:

One measure of cement equal to the best quality of freshly-burned Cumberland or Sheperdstown cement, manufactured upon the formula of this office, and two of clean, sharp, washed sand, free from clay, will be thoroughly mixed, dry, and then made into a mortar with the least possible amount of water; broken stone or brick, thoroughly cleaned from dust and dirt, drenched with water, but containing no loose water in the heap, will then be incorporated immediately with the mortar in such quantities as will give a surplus of mortar when rammed. This proportion when ascertained will be regulated by measure. Each batch of concrete will be thoroughly mixed, the mixing being

continued on the board until each piece of stone or brick is completely coated with mortar; it will then be spread and at once thoroughly compacted by ramming until free mortar appears upon the surface. The whole operation of mixing and laying each batch will be performed as expeditiously as possible, with the use of a sufficent number of skilled men. No gravel will be used in the concrete, but only angular fragments of stone or brick, having rough faces obtained by fracture, and measuring not more than 2½ inches in their largest dimensions. The upper surface will be made exactly parallel with the surface of the pavement to be laid, and will be protected from the action of the sun and wind until set. Upon this base will be laid the wearing surface or pavement proper, the basis of which, or paving cement, will be pure asphaltum, unmixed with any of the products of coal-tar.

3. When the pavement is laid adjacent to the track of a street railway, a strip two feet wide of paving blocks of granite or syenite will be laid next the track, with a foundation of bituminous concrete extending to the depth of the bottom of the cross ties. This foundation will consist of small broken stone, clean, sharp sand, and paving cement of coal-tar from direct distillation, of the consistency usually numbered between four and five. The ingredients and relative proportions of this foundation will be such as to constitute a solid base of broken stone, the voids of which are filled with sand and paving cement, and will require the approval of the engineer commissioner. The joints between the paving blocks will be filled with a hot paving cement, composed of refined asphalt, 100 parts, and heavy petroleum tar, 10 parts; or a cement obtained from the direct distillation of coal-tar, and of the consistency ordinarily numbered between 5 and 6.

These blocks will be laid as headers, and the alternate courses will be 22 and 26 inches in length, so as to form a toothing where the stone pavement meets the asphalt. The width of the blocks will be from 4 to 6 inches, and their depth from 5 to 6 inches. The dimensions here given will be strictly adhered to, and the blocks must be of durable and uniform quality, selected for this purpose. The blocks will be carefully inspected after they are brought upon the line of the work, and all blocks which do not conform, in quality and dimensions, to these specifications, will be rejected. Contractors will be required to furnish such laborers as may be necessary to aid the inspector in the examination and culling of the blocks; and in case the contractors shall neglect or refuse so to do, such laborers as, in the opinion of the engineer commissioner, may be necessary, will be employed, and the expense incurred will be deducted and paid out of any money then due, or which thereafter may become due to the contractors. The blocks may be of any syenite or granite, equal in hardness to what is known as Quincy granite; but hard basaltic stone that will take a smooth polish under traffic will not be used.

When the new pavement joins an existing wood pavement, a 3-in. pine plank will be set on edge between the two, and both pavements filled well up against it. Where the new pavement joins an existing stone pavement, a line of parking curb will be set on edge between the two. This curb will be furnished by the district at G street property yard, and must be hauled to the work and placed in position at the contractor's expense.

4. The following specifications for wearing surface will be adhered to, unless a more satisfactory pavement should be presented.

The wearing surface will be composed of:

1st. Refined Trinidad or Cuban asphaltum.

2d. Heavy petroleum oil.

3d. Fine sand, containing not more than one percentum of hydro-silicate of alumina.

4th. Fine powder of carbonate of lime.

The Trinidad asphaltum (so called), whether crude or refined, as found in this market, contains from 20 to 35 per cent. of impurities, and must be refined and brought to a uniform standard of purity and gravity.

The Cuban asphalt contains a quarter percentage of asphaltum, and less of petroleum than the Trinidad asphalt, and therefore requires a larger percentage of heavy petroleum oil to make an asphaltic cement of a similar quality as to its malleability.

The heavy petroleum oil, which may be the residuum, by distillation, of the petroleum oils as found in the market, generally contains water, light oils, coke and a gummy substance soluble in water. This petroleum oil must be free from all impurities, and brought to a specific gravity of 18° to 22° Beaumè, and a fire test of 350° Fahr.

By melting and mixing these two hydro-carbons, petroleum oil and asphaltum, the matrix of the pavement called asphaltic cement is manufactured, which cement shall have a fire test of 250° Fahr., and at a temperature of 60° Fahr. shall have a specific gravity of 1.19.

They will be mixed in the following proportions, by weight:

With Trinidad Asphalt.

Pure asphalt	100 parts
Heavy petroleum oil	20 "

With Cuban Asphalt.

Pure asphalt	100 parts
Heavy petroleum oil	30 "

The purity of the asphalt shall be ascertained and the quantity of heavy petroleum oil to be added to it shall be in accordance with the percentage of pure asphalt which it contains when crude, whether Cuban or Trinidad asphalt.

The asphaltic cement being made in the manner above described, the pavement mixture will be formed of the following materials, and in the proportions stated:

Asphaltic cement	from 15 to 18	
Sand	" 70 " 65	
Pulverized carbonate of lime	" 15 " 17	
	100	100

In order to make the pavement homogeneous, the proportions of the asphaltic cement must be varied according to quality and character of the sand. The engineer commissioner or his inspectors will make frequent inspections of the works when the paving mixture is manufactured, and will specify the exact amount of asphaltic cement between the limits above given which shall be used in each batch.

The sand and asphaltic cement are heated separately to about 300° Fahr. The pulverized carbonate of lime, while cold, is mixed with the hot sand in the required proportions, and is then mixed with the asphaltic cement at the required temperature, and in the proper proportions, in a suitable apparatus which will effect a perfect mixture.

The pavement mixture, prepared in the manner thus indicated, will be laid on the foundation in two coats. The first coat, called "cushion coat," will contain from 2 to 4 per cent. more asphaltic cement than given above; it will be laid to such a depth as will give a thickness of ⅛ inch after being consolidated with a roller. The second coat called "surface coat," prepared as above specified, will be laid on the cushion coat; it will be brought to the ground in carts at a temperature of about 250° Fahr., and if the temperature of the air is less than 50° the contractor must provide iron carts with heating apparatus, in order to mantain the proper temperature of the mixture; it will then be carefully spread, by means of hot iron rakes, in such manner as to give a uniform and regular grade, and to such depth that, after having received its ultimate compression of two-fifths, it will have a thickness of 2 in. The surface will then be compressed by hand-rollers; after which a small amount of hydraulic cement will be swept over it; and it will then be thoroughly compressed by a steam-roller weighing not less than 250 lbs. to the inch-run, the roller being continued for not less than 5 hours for every 1,000 yards of surface.

The degree of fineness, both of sand and powdered limestone, will be determined by testing with the screens now on file in the Engineer Department.

The powdered carbonate of lime will be of such degree of fineness that 16 per centum by weight of the entire mixture for the pavement shall be an impalpable powder of limestone, and the whole of it shall pass a No. 26 screen. The sand will be of such size that none of it will pass a No. 80 screen; and the whole of it will pass a No. 20 screen.

In order to make the gutters which are consolidated but little by traffic entirely impervious to water, a width of 12 inches next the curb will be coated with hot pure asphalt, and smoothed with hot smoothing irons, in order to saturate the pavement to a certain depth with an excess of asphalt,

5. If considered advisable, a strip of granite block pavement will be laid in place of the gutter, of such width as may be prescribed, and in accordance with the specifications for granite block pavements. In this case, the edge next the carriage-way will consist of headers toothing into the pavement of the carriage-way.

NEWS OF THE WEEK.

MEXICAN PENINSULA TELEGRAPH AND TELEPHONE CO.—Frederick M. Delano, Henry C. De Rivera, and Charles Rabadan, all residents of this city, have formed a corporation known as the Mexican Peninsular Telegraph and Telephone Company. The purpose of the new company is to build and operate telegraph lines running from this city to and across Staten Island to New Jersey, and thence in as direct a line as practicable to and through the States of Yucatan, Campeche, Tabasco, Chiapas, and Oajaca, in the republic of Mexico. The capital stock of the company is $500,000, divided into $50,000 shares of $10 each, of which Frederick Delano holds 20,000, Henry C. De Rivera 15,000, and Charles Rabadan 15,000.

LACKAWANNA & PITTSBURGH.—A contract has been let to D. D. Warren, of Springfield, Mass., to build this road from Perkinsville, N. Y., on the Delaware, Lackawanna & Western's Buffalo Division, to Belfast, 22 miles.

THE NATIONAL PARK EXTENSION.—A contract has been let by the Northern Pacific to H. Clark, of Rochester, N. Y., and Austin Mathers, of Minneapolis, to build the National Park Division, sixty miles along the left bank of the Yellowstone and with Livingston as the northern and Geyser Basin as the southern termini respectively. Work will be pushed forward with all possible rapidity, and, as the line surveyed is comparatively level, Mr. Clark hopes to have the track ready for tourists' train by the 1st July.

CHICAGO, ST. LOUIS & PITTSBURGH.—The Columbus, Chicago and Indiana Central, which was recently sold to satisfy a mortgage of $13,500,000, to William L. Scott, has been incorporated under the name of the Chicago, St. Louis and Pittsburgh, with William L. Scott, John B. Drake, R. Biddle Roberts, J. N. McCullough, Thomas D. Messler, George Briggs, and William Borner as directors. This company a few days ago executed in favor of Conrad Baker, of Indianapolis, and the Union Trust Company of New York, as trustees, a first mortgage for $22,000,000 payable Oct. 1, 1932. The new company is organized subordinate to and in the interest of the Pennsylvania Company.

IN the *North American Review* for April, the scriptural and the legal aspects of divorce are presented respectively by the Rev. Dr. Theodore D. Woolsey, well known for his insistance on the indissolubility of the marriage tie, and by Judge John A. Jameson, a jurist whose long experience with divorce cases in Chicago, both on the judicial bench and at the bar, lends to his observations a very special value. Dr. P. Bender, a Canadian, who has studied to some purpose the political, social, and economic conditions of his country, under the title, "A Canadian View of Annexation," makes a forcible presentation of the reasons which incline many citizens of the Dominion to regard with favor the idea of absorption by the United States. Senator John A. Logan sets forth the need which exists for "National Aid to Public Schools" in the several States and Territories. The Rev. Dr. Howard Crosby writes of "The Dangerous Classes" that menace the perpetuity of civil order and the peace of the community, meaning the manipulators of corporation stocks and the men who, having amassed enormous wealth, use it for nefarious purposes. James C. Welling, President of Columbian University, treats of "Race Education," the problem that confronts the philosophic statesman, of the presence in our body politic of a strong Negro contingent. "The Water Supply of Cities" is discussed by Charles F. Wingate, "Ethical Systems" by Prof. F. H. Hedge, "Street Begging" by Rev. Dr. Charles F. Deems, and "Criticism and Christianity" by O. B. Frothingham. Published at 30 Lafayette Place, New York, and for sale by booksellers generally.

BUILDING CONTRACT LET.—The Board of Public Improvements of St. Louis has awarded the contract for erecting additional buildings at the House of Refuge grounds to Chas. Webking at $36,000.

NEW BRIDGE FOR LONG BRANCH, N. J.—The Board of Chosen Freeholders has passed resolutions favoring the building of a draw-bridge over the South Shrewsbury River, from the road leading from Rumson Neck to Pleasure Bay, shortening the drive from Little Silver to the sea-shore four miles and the drive from Red Bank two miles.

LAST CONTRACT ON THE NORTHERN PACIFIC.—The last contract that will ever be let on the main line of the Northern Pacific Railroad was closed last Saturday. On that day Messrs. Winston Brothers, of Minneapolis, and H. Clark, of New York, were awarded the contract for completing the Northern Pacific track from the present eastern terminus of the western or Pacific division into Helena, the capital of Montana. The 150-mile contract will include the main summit of the Rocky Mountains.

SEWER CONTRACT LET—MILWAUKEE, Wisconsin, March 13.—William Forrestal J. C. Brand and Dennis Trainor contracted to-day to build six miles of sewer in Minneapolis. The consideration is $150,000.

A PANAMA CANAL DREDGE LIBELED.—PHILADELPHIA, March 15.—The departure of the large steam dredge Count de Lesseps, which is intended to be used on the Panama Canal, and which is in readiness to be towed to the Isthmus by the steamer Claudius, which came here from New York for that purpose, will probably be delayed by an attachment brought against the dredge by the I. P. Morris Company this morning. This firm filed a libel in which they set forth that the dredge was formerly known as the Hercules No. 1, and that $11,000 is still due the firm on a contract for supplying her with machinery and furniture. The United States Marshal will attach the dredge this afternoon, and security must be entered in $14,000 before she will be released.

MORRISTOWN, PA. R. R. BRIDGE BURNED.—The bridge over the Schuylkill at Morristown, Pa. connecting the main line of the Reading R. R. with the Philadelphia and Morristown Branch, was burned on the evening of March 15. This bridge was a large covered wooden structure, with one track and a carriage-way; and it had four spaces of about 150 ft. each, and was built about 50 years ago. The bridge is a complete wreck, loss about $60,000.

GAS-WORKS AT CLINTON, MO.—Messrs. Ireland & Andrews have been awarded the contract by the city board to erect gas-works, and will break ground as soon as the weather permits.

LABOR NOTE.—A meeting of the stone masons of Boston on Monday evening resolved that workmen at that trade should demand $4 a day on and after May 1.

PHILADELPHIA AND ATLANTIC CITY R. R.—Control of this road has been bought by the New Jersey Central R. R. Co. The Philadelphia and Atlantic City is a narrow-gauge road extending from Atlantic City to Camden, N. J., a distance of 54.67 miles. The plan is to change the road to a standard gauge, to conform to the Central.

N. P. EXTENSION.—Instructions have been sent to Andrew Anderson, Chief Engineer of the Northern Pacific Railroad, to advertise for bids for the extension of the road from Superior City, Wis., the present eastern terminus, to Ashland, a distance of 90 miles, where connection is made with the Wisconsin Central Railroad, the President of which, Mr. C. L. Colby, has been in this City negotiating for the construction of the line. The road would cost about $25,000 a mile, and it would take a year or more to build it. The line runs through dense forests.

ARCHITECTURAL IRON-MAKERS.—The certificate of incorporation of the Society of Architectural Iron Manufacturers was filed in the County Clerk's office, N. Y., on the 13th. The corporators are John B. Cornell, James J. Burnet, John B. Radley, Andrew J. Campbell, John Henselman, James J. Healey and Charles Hewlett. Its purposes are to advance the interests of the architectural iron trade, to promote the frequent interchange of ideas relating to the manufacture of architectural iron work, and generally to promote, collect, preserve and disseminate information respecting such work.

CHARLES DE LESSEPS AT PANAMA.—M. Charles de Lesseps and a number of engineers have arrived at Panama from France. A powerful dredger is expected in about a week from the United States, and then work on the mouth of the canal, on the Atlantic, will be formally commenced. A "boom" in canal matters is promised by those interested. The dredge Vicomtesse de Lesseps, in tow of a powerful tug, is now en route from Philadelphia to Panama. It is the largest dredger in the world.

WANTING TO BUILD A ROAD.—VICTORIA, B. C., March 12.—Two companies are applying for charters to build a road from the lower river to the boundary line. The capital of one company is $1,000,000, and of the other $500,000. No lands are asked for, merely the right of way. The scheme to cede lands in Kootenay to an American company in consideration for the construction of a railway and the establishment of a line of steamboats meets with the general condemnation of the press.

A NEW PROJECT.—A railroad company was recently organized in Nebraska to build a road from Dodge City, Kan., to Omaha, and the statement is made that it is a move to give the Chicago and Northwestern a connection with the Atchison, Topeka and Santa Fe, thus tapping the through trade of that road before Missouri River points are reached, and affording a somewhat shorter route to Chicago. Dodge City is reported to be the greatest cattle market in the world.

CANADIAN PACIFIC.—The Canadian Pacific is reported to be one of the richest corporations in the world. It started out with a grant of 766 miles of road built and in operation, another grant of 25,000,000 acres of land said to be worth on the average $5 per acre, and a government guarantee of the clear gift of $25,000,000, to be paid in installments, so much upon the completion of each twenty miles. Its charter exempts the road, equipment and capital stock from taxes forever, and it has free right of way, with all the materials for construction and equipment free from duty. It is stated that the line when completed will cost about $60,000,000, of which the government pays $25,000,000, leaving for the company but 35,000-000, which 7,000,000 acres of their land grant from Winnipeg westward will pay. This will leave untouched their entire capital stock and 18,000,000 acres of land.

NEW JAIL.—A contract for a new jail for Prince George County, Va., was let last week.

RICHMOND, VA., GAS-WORKS.—At a meeting of the Aldermen of Richmond, Va., held on Monday last, the proposed appropriation for re-modeling the Gas Works of that city was lost by a vote of 10 to 7.

OGDENSBURGH & LAKE CHAMPLAIN R. R.—A new route to the seaboard, in the Vanderbilt interest, has been secured by the lease in perpetuity, on completion, of the Lamoille Valley Extention R. R. to the above company.

THE PHILADELPHIA, GERMANTOWN & CHESTNUT HILL RAILROAD.—This company has awarded the contract to erect the piers and abutments of an iron bridge across the Schuylkill, at Manayunk, to E. D. Smith. The bridge will be two tracks in width and 1,600 feet in length. There will be two spans of 240 feet each. There will be but one pier in the river. The bridge will be eighty feet above the water level, and will cost about $250,000.

BROADWAY UNDERGROUND R. R.—The annual meeting of the company, which was postponed from Oct. 1, took place on the 13th in the office of Melville D. Smith, No. 115 Broadway. The annual election of officers resulted in the choice of Mr. Smith as President; Edward M. Clymer, Treasurer, and John Cummins, Secretary. Ex-Secretary William Windom and Jerome Fassler, Sr., of Springfield, Mass., have recently become members of the Board of Trustees, the others being Mr. Smith, Mr. Clymer and Henry C. Gardiner. The maps and plans of the company have been completed, and the Trustees intend to make every effort to push their project.

BELL'S GAP R. R.—It is proposed to extend this road northward from Ramey through Clearfield and Indiana Counties to Punxsutawney, in the latter county, a distance of 32 miles. The route will be an easy one—up Witmer Run to the summit and down Wilson's Run. The grades will be much lighter than on the Bell's Gap Road, not exceeding eighty feet to the mile on either side of the summit. The capital stock of the road will be a million, of which 10 per cent. has been paid in. The directors are Charles Berwind, Aaron Fries, John Reilly, J. N. Dubarry, F. S. Lewis, John H. Converse and Allison White.

THE ROCHESTER & PITTSBURGH R. R.—This company contemplates an extension to Punxsutawney, and they, in partnership with the Vanderbilt and Wallace interests, have already made arrangements to head off the Bell's Gap R. R. with the Susquehanna and Allegheny, for which a charter was obtained a fortnight ago. This line is projected to extend from Punxsutawney, Young Township, Jefferson County, through Jefferson, Indiana, Clearfield, Centre, Clinton, Lycoming, and Union Counties to West Milton, on the Susquehanna River, where it will connect with the Reading. The distance is 150 miles, and the capital stock is $1,500,000. The cost is reckoned at $10,000 per mile, and the 15,000 shares are valued at $100 per share. The directors are Wallston H. Brown, New York, who is the principal stockholder, having 7,400 shares; Fred A. Brown, New York; Thomas F. Wentworth, New York; Herbert P. Brown, New York, and E. G. Platt, Philadelphia; Victor Guillon, Robert Maxwell, John Rogers and Frank M. Rodgers, all of Philadelphia. Wallston H. Brown is President.

It will be noticed that the President is one of the leading capitalists in the Rochester and Pittsburgh, and one of the members of the Construction Company which is building that road. He is of the firm of Brown, Howard & Co., the contractors who built the Nickel Plate. The Clearfield and Jefferson has the advantage of the start and the control of the best lands and those nearest a market, but the other party commands a great deal of capital, and it would not be at all surprising to see both roads built.

THE SUSQUEHANNA & ALLEGHANY R. R.—Length 150 miles; to start from near Punxsatawney, Jefferson county, and run through the counties of Indiana, Clearfield, Clinton, Lycoming, and Union. Capital $1,500,000, owned by Philadelphia and New York capitalists. W. H. Brown President, with headquarters at Philadelphia.

A NEW EXPLOSIVE.—Our highly esteemed contemporary, the New York *Times*, publishes the following startling intelligence:

"News from Cuba—Explosion and death of Six Negroes."

Hitherto the negro has not been considered by chemists to be an explosive. Formerly, before investigation had set forth his true characteristics, he was held to be an amorphous form of carbon. Prof. Doremus, however, after a careful series of experiments, disproved this theory, and conclusively showed that the negro was a complex nitrogenous compound of low specific gravity, very volatile at ordinary temperatures, and easily soluble in alcohol and water, but offering a high resistance to detergents. He had great affinity for several bases, notably 'possum and watermelon, and would combine with them readily without the aid of heat. He also seemed to possess a catalytic power when exposed to hen roosts, deorganizing those bodies with such rapidity that their component parts could never again be brought together. In this, as Prof. Doremus clearly demonstrated, the negro was not aided by solar actinism, for the catalysis was most rapid in the dark of the moon, while by daylight the most easily decomposable roost could be exposed to him in perfect safety.

If now the negro is shown by the *Times* to be an explosive, it is most important to science and to the general public that he be thoroughly investigated at once, and the following questions are submitted for the guidance of the experts who may undertake this important task:

I. Are only Cuban negroes explosive?

II. Under what conditions of heat or compression, or both, do they explode?

III. Is the explosion of negroes detonating in character, like that of nitro-glycerine; or is it the result of rapid combustion, as in the case of gunpowder; or does it partake of both these qualities like that of pyroqyline; or is the negro a true fulminate?

IV. Into what gases does the explosion of the negro resolve him, and what is the residuum?

V. Does the explosion of a negro necessarily cause his death? If so, why?

VI. In time of war, could explosive negroes, properly armed with a fuse, be made to serve as shells? If so, how many?

VII. What would be the effect of a continued bombardment with explosive negroes?

The subject is vast and complicated, but unless it is grappled with in earnest, the truth may never be positively ascertained.—*N. Y. Sun.*

NEW ORLEANS & NORTHEASTERN R. R.—Work on this line is being pushed vigorously. Construction trains on the north shore of the lake have double crews and run all night, carrying large quantities of bridge material from the creosote works to the end of the track, where there is a number of culverts in course of construction. As soon as the track reaches the Pearl River, the work of building the bridge across that stream will be greatly expedited.

THE FATE OF AN ANCIENT WEATHER PROPHET.—The career of Wiggins calls to mind the punishment which Dean Swift and some of his friends inflicted upon a weather-prophesying impostor in Queen Anne's time, known as Partridge, the almanac maker. Partridge started in life as a shoemaker; but he soon left that for the more profitable and less laborious pursuits of quack, prophet, and humbug generally. His pretensions imposed on credulous people and his almanacs were bought by the thousands. To show what sorry quacks Wiggins and Vennor are, notwithstanding the lapse of two centuries, during which the art of humbugging has been developed immensely, they have not improved in the least on Partridge's system. He, just as they, foretold storms in March and December, showers in April, hot weather in August, and frosts in November, and made as loud boasts as if a hit was made.

Swift became disgusted at Partridge's pretensions, and determined to put him down. Walking around London one day, he noticed over a smith's shop the sign, "Isaac Bickerstaff." It struck his fancy, and he stored it in his memory for future use. In January, 1708, Partridge came out with his almanac as usual. A few weeks afterward London was astonished by the publication of a small sheet, which purported to certain the predictions of Isaac Bickerstaff, astrologer. It made a profound sensation, and the sale was great. Instead of the vague and indefinite hints at futurity which Partridge's almanacs contained, it foretold foreign and domestic events with the greatest particularity, giving even the hour of the day when deaths of famous men, great victories and defeats should occur. But one statement created the most talk; for at 11 o'clock on the 29th of March it was predicted that Partridge, the almanac maker, would die. Partridge himself stoutly denied its truth; but it was of no use. On the 30th of March another pamphlet came out giving a circumstantial account of his death, after a sincere repentance of his sins and a confession of the worthlessness of his almanac. Everybody believed he was dead, and Partridge was never able to convince the public that he was still alive. It broke up his business, and in a few years he really did die. It is a pity that the Dean isn't still on earth to deal with Vennor and Wiggins. A good dose of ridicule is probably the most effectual weapon which can be used against them, and the Dean was a master of the art.—*Boston Globe.*

THE SMITHSONIAN INSTITUTE.—An appropriation of $50,000 was made by the last Congress to be expended in making the building fire-proof. The interior is, at present, of wood, and contains two stories. When remodeled, according to the very comprehensive plans which are furnished, it will be iron-lined and four stories high. The rooms which are to be changed, are the historical, over where Prof. Henry lived and died, and comprise about one-third of the entire edifice.

PITTSBURGH, CINCINNATI & ST. LOUIS R. R.—Works on the new city transfer depot and shops at Indianapolis will soon be commenced. The plans have been accepted.

WASHINGTON IMPROVEMENT CO.—This company has been incorporated at Seattle, W. T. The primary object of the new company is to cut a canal to connect the waters of Lakes Union and Washton, back of Seattle, and incidentally to supply the city with water, run steamboats on the lakes and use the power to be obtained for the purpose of manufactures.

PROPOSALS FOR GRANITE BLOCKS.—The Boston committee on paving will receive proposals until March 22 for furnishing granite paving block for Boston during the year 1883.

ELECTRIC LIGHT FOR HELL GATE.—The Lighthouse Board has leased the property at Hallett's Point, Hell Gate, New York Harbor, selected as a

site for the new electric light tower, the erection of which will soon be commenced.

SUSSEX MIDLAND R. R.—This road has been incorporated in Delaware.

HEATING CARS BY STEAM.—The Maine Central is trying a new system of heating its cars by steam from the locomotive. The heat is regulated in each car by a valve midway in the aisle.

STEEL STEAMSHIPS.—The Portland (Oreg.) *News* says: "Contracts have just been let by Mr. Villard for the construction of two splendid steel steamships for use on Puget Sound. They are both alike, each 260 ft. in length, and built with a view of obtaining the highest possible speed. They are to make at least twenty miles per hour and are designed to run between Seattle and Victoria, British Columbia, in connection with the Northern Pacific and the Canadian Pacific."

OHIO RIVER R. R. COMPANY.—A contract has been let for constructing the road from Wheeling, W. Va., to Parkersburg, a distance of 90 miles. The line will be extended in time to New Orleans. As soon as the right of way has been secured, the second section of the road to Mount Pleasant, a distance of 70 miles, will be let.

THE ST. CHARLES BRIDGE.—A large force of mechanics and laborers are busy as beavers around the St. Charles bridge. They are driving piling, loading barges with stone, and framing heavy timbers, all intended for temporary piers under the Fink spans to replace the supports cut away by ice. As soon as these piers and other false work have been completed, new wrought-iron girders are to supplant those of cast iron now in the Fink spans.

OCALA & TAMPA R. R.—GAINESVILLE, FLA., March 8.—Gangs of men have cleaned two miles of the line of Gen. Gordon's railway from Ocala toward Tampa and grading has begun. This is the old Tropical Railroad, whose charter would have expired to-day if work had not been begun. Great surprise is expressed here at the promptness with which Gen. Gordon has commenced operations. It is understood that the entire road from Ocala to Tampa will be pushed through as rapidly as possible. Bosses are hiring great gangs of laborers.

LAMOILLE VALLEY EXTENSION R. R.—This company, at a meeting held at St. Johnsbury, Vt., voted to issue bonds to the amount of $350,000 to complete the road and accept of Phelps-Vanderbilt contract, which leases the road on completion in perpetuity to the Ogdensburg & Lake Champlain Railroad. This road forms a connection between the Ogdensburg & Lake Champlain and the St. Johnsbury & Lake Champlain Railroads, forming a through line from the West to the seaboard. Contracts have been made and work commenced, and it is expected the road will be completed by Sept. 1 next.

TURLOCK & SIERRA NEVADA R. R.—The San Francisco *Chronicle* says this road has been organized and papers of incorporation drawn. It will run from Turlock into the Sierra Nevada, via Merced Falls.

OFFICE OF STATE ENGINEER OF TEXAS.—Texas has a law which authorizes the Governor to appoint some person to act as State Engineer, who shall have the right and power to compel all railroads that connect with each other in that State to make their connections regular and proper, so as to accommodate the traveling public on said roads, and the right and power to compel said companies to draw the passengers and freight of each other on their respective roads and cars, and upon a refusal to comply with these requirements, such person shall take charge of the road and rolling-stock, and report it to the Governor. The said road shall then be run for the benefit of the State until satisfactory arrangements are made for a compliance with the law.

CAPE COD CANAL.—The senate committee of the Massachusetts Legislature reports adversely upon the petition of Henry Stuckles to be allowed to cut a canal at Cape Cod with foreign capital.

WAGES IN ST. LOUIS.—Hod carriers on a large building have struck for $3.25 per day.

ELECTRIC LIGHT.—Dayton, O., has now 40 electric lights.

STRAW BOARDS.—The Akron-Portage Straw Board Company has commenced operations at New Portage, near Akron, Ohio.

THE MALAY PENINSULA—SAN FRANCISCO, March 9.—Advices from Bangkok, Siam, to Jan. 15: The French engineers sent out by De Lesseps to survey the isthmus of Krald for a projected ship canal had departed for the Malay peninsula to commence work. At Bangkok they were received by the king and entertained by Gen. Halderman, American minister. They received many courtesies at the hands of Siamese princes and nobles.

PRICE OF GAS AT JOHNSTOWN, PA.—The price of gas has been reduced from $2.50 to $1.80 per thousand feet.

A BOLD SCHEME OF ENGINEERING.—A survey is about being made through the heaviest portion of the Black cañon of the Gunnison. For a long distance the walls of syenite rise to the stupendous height of 3000 feet, and for 1800 feet the walls of the cañon are arched not many feet from the bed of the river. If the survey is successful and the Denver & Rio Grande is built through the cañon, it will undoubtedly be the grandest piece of engineering on the American continent. The river is very swift, and it is proposed to build a boat at the western end and provision it for a length of time, allowing it to float with the stream, but controlled by ropes. If the boat goes the chances are that the baby road goes too.—*Denver Tribune.*

WISCONSIN CENTRAL R. R.—This road will soon send out a surveying party to locate the new line through the Penokee iron range, to be built by the company next season. The new line will be 30 miles in length, in the center of the iron district.

KANSAS CITY, FORT SCOTT & GULF R. R.—Tracklaying on the Memphis extension of this road has been completed to the station of Koshkonong, 125 miles east of Springfield, Mo. From Koshkonong to Memphis the distance is 152 miles, of which about 40 miles of the track has been laid, on each side of the Iron Mountain and Southern, which leaves 112 miles of track yet to be put down. The entire length of the road between Kansas City and Memphis will be 482 miles.

THE MILE.—A nautical mile, or an English admiralty knot is 6,080 feet. The United States Coast survey, always most accurate in such things, has adopted 1,853.248 meters, or 6,080.27 feet, as the standard mile, which is popularly "a minute of latitude," but more accurately the sixtieth part of a degree on the great circle of a sphere whose surface is equal to the surface of the earth. A minute of latitude, according to the head of the Coast Survey, would be 1,861.655 meters at the poles, and 1,842.787 meters at the equator. One minute of the equator would be 1,855.345 meters, or 6,087.15 feet.

DRAINAGE CONTRACT LET.—The contract for the drainage system of the Syracuse depot and hotel of the New York, West Shore & Buffalo Railroad, has been awarded to the Durham House Drainage Co. of New York.

THE SIEMENS GAS-BURNER.—For some time past, says the New York *Evening Post*, the Manhattan Gas Company have had burning in their offices at Irving place and Fifteenth street four Siemens burners, received several months ago, which give wonderful results and will be introduced for street illumination when some more are received from France, where they are now made. The effort of Frederic Siemens has been for years to get more out of gas than ordinary burners effect. He has at last hit upon a device by which the air which mingles with the gas at the time of combustion is heated by contact with porcelain conductors at a white heat, while at the same time the flicker caused by imperfect combustion at the edges of the flame is done away with by causing the flame to double upon itself in such a manner that combustion is complete and the flame perfectly steady. If the flame of an argand gas-burner, after reaching to nearly its natural height, was turned inward and drawn by suction down through the tube of the burner it would follow about the same course as the flame in a Siemens burner. The vacuum which draws the flame down is caused by the rush of the heated air which goes to feed the flame. According to the experiments of the engineer of the Manhattan Gas Company, the gas burned in the 500-candle Siemens burners, now in use, gives twice the light the same amount of gas burned in an ordinary burner of the best construction would give. So far no burners of this Siemens pattern have been made of less power than 500 candles. In these burners the flame is so large and hot that the porcelain is heated to a degree not possible in a small burner for domestic use. Siemens is experimenting with small burners, but no important results have yet been announced.

ARTESIAN WELL AT DENVER.—While miners were sending a blind shaft for coal in North Denver, Col., a stream of water was struck at a depth of 375 feet. This is the first artesian well opened in the State, although nearly $100,000 has been expended by the Government and corporations in experimental sinkings. It is proposed to systematrically establish wells in the neighborhood of the accidental discovery, with a view to developing the rich lands there for horticultural purposes.

VERA CRUZ HARBOR.—A French engineer, E. Thiers, has arrived in Vera Cruz, representing a strong French company, who desire to contract for the work of improving that harbor. His plans, which are said to be comprehensive and practicable beyond any yet presented, have been laid before the council and referred by them to a committee.

THE BROOKLYN BRIDGE.—The committee on lighting has made a contract with the United States Electric Light Company of this city, by which the company agrees to furnish the plant and operate it for 30 days, and if accepted by the engineers $15,500 will be paid. The plant includes two 50 horse-power Corliss engines and the necessary machinery, wires, etc., for 70 lamps. The work is to be completed on or before April 15. The company will give a bond indemnifying the trustees from any suits for infringement of patents.

Bids had been received as follows for 20,000 lineal feet of lattice rail for each side of the bidge and each side of the promenade: J. B. & J. M. Cornell, $13,000; D. Y. Saxton, $11,764; Composite Iron Works, $12,308; Manly & Cooper of Philadelphia, $9,996. Upon the recommendation of Chief Engineer Roebling, the contract was awarded to Manly & Cooper, on the added condition that they engage to have the work done by May 1, or pay a forfeit of $25 a day for every day after that time.

WATER-WORKS, TYLER, TEX.—These works have been tested and found satisfactory in every respect.

CITY HALL CONTRACT LET.—The Board of Aldermen of Indianapolis, Ind., has let the contract for building the new city hall to M. K. Fatout, at $134,460.

WATER-WORKS SOLD.—The water-works at Santa Fé, N. M., have been sold under a $20,000 mortgage.

STONE MASONS' WAGES.—The stone masons of Boston will demand $4 a day after May 7.

GAS-WORKS AT FORT SCOTT, KANSAS.—J. W. Pinkston, of Fort Scott, has been granted a franchise by the city, to build gas-works and light the city.

PROPOSALS FOR WHITE MARBLE OR GRANITE.—Lieut. Col. T. L. Casey, Washington, D. C., will receive proposals until March 26, for furnishing the following quantities of white marble and granite for the Washington Monument: Forty-two thousand (42,000) cubic ft. (more or less) of white marble, or ten thousand (10,000) cubic ft. (more or less) of rough granite.

WATER-WORKS FOR EAST WEYMOUTH, MASS.—Certain citizens of East Weymouth have petitioned the Legislature to be incorporated as a water company.

THE IRON AND METAL MARKET.

PHILADELPHIA, MARCH 15.

Lowest selling prices for iron and steel at this Market to-day, are as follows: No. 1, Foundry, $24@$25.50; No. 2, $22.50@$23; Gray Forge, $20@$21; Bessemer Iron, $22; Scotch, $22@$26, according to brand; English Iron, $20; Muck Bars, $36@$36.50; Merchant Bars, 2@2.30c.; Nails $3.15@$3.30; Spikes $2.65@$2.75; Angle Iron, 2.50c.; Tees, 3.20c.; Beams and Channels, 2.40@3.50c.; Tank, 2.40@2.50c.; Shell, 3.40c.; Flange, 4.40c.; Fire-box, 5.25@5.50c.; Wrought pipes, 67 ½@70 per cent. off; Steel Rails, $39@40; Old Rails, $25@$25.50; Double Heads, $27; Scrap, $25@$26 for common, $26@$27 for best. Business is slowly improving and prices are fluctuating in buyers' favor. Large transactions are exceptional.

PITTSBURGH, MARCH 15.

Within three days a moderate improvement has taken place in the demand for nearly all kinds of iron, but buyers are still holding back lest some weakness may suddenly develop. Prices are without that firmness which the trade looked for, and demand is only slowly improving. Inquiry is encouraging and an active demand is probable in a few days. Mutual Mill, $19.50@$20; Red Short, $20.50; Foundry Irons, $22@$23; Charcoal, $27; Car wheels, $30; Bessemer, $22.50; Muck bars, $35; Manufactured Iron, 2c. in large lots, to 2.15c. in small lots; Nails, $3.40 in small lots. Production increases to full time next Monday. Steel is quiet and weak. Steel rails, $40 at works. Old Rails are without activity; Scrap Iron, $25 for No. 1; Railway Scrap, $27@$28.

CHICAGO, MARCH 15.

The Northwestern iron markets are dull and prices weak. The improvement in demand confidently predicted two weeks ago is only slowly taking place. Inquiry is improving, but thus far buyers have been satisfying themselves with small lots at about 2.37c.; angle iron, 3.10c.; beams, 3.80c.; tank, 3c. Pig iron quotations are unchanged. No. 1, $24; No. 3, $25; American Scotch, $24. The demand for tool machinery and agricultural steel is slowly improving, but for small lots. Inquiries for rails are being received, but no large contracts have been placed, although negotiations are in hand.

Prices at Louisville are low and current demand is restricted chiefly to small lots, although the inquiries received within a week indicate that an active demand is not far distant. Barbed wire has declined and agricultural machinery is in better request. At Cincinnati the inquiry for finished iron and steel for agricultural and machine-shop purposes has shown an improvement, but prices are weak. Notwithstanding this, buyers are not disposed to cover more than current requirements. Makers expect a lively demand and are rather surprised that the low prices do not attract more business.